

CONSERVATION ASSESSMENT OF SENSITIVE MOONWORTS  
(OPHIOGLOSSACEAE; *BOTRYCHUM* SUBGENUS *BOTRYCHUM*)  
ON THE KOOTENAI NATIONAL FOREST

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Agreement No. 11011454002

February 1997

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This document should be cited as follows:

J. Vanderhorst. 1997. Conservation assessment of sensitive moonworts (*Botrychium* subgenus *Botrychium*) on the Kootenai National Forest. Montana Natural Heritage Program, Helena, MT. 82 pp. plus appendices.

## SUMMARY

Over one hundred occurrences of six sensitive or proposed sensitive *Botrychium* species are documented on the Kootenai National Forest. These include most of the largest known populations of *B. minganense* and *B. montanum* in the state and a few large populations of *B. crenulatum*. There are also a few small occurrences of three extremely rare species, *B. ascendens*, *B. paradoxum*, and *B. pedunculosum*. The sensitive *Botrychium* species occupy a variety of moist habitats distributed across the glaciated landscapes of Forest; mostly western red cedar and western hemlock habitat types in the western part and mostly deciduous wetland habitat types in the eastern part. Primary potential threats to populations include direct impacts of logging and road building to upland occurrences and indirect and cumulative effects of these activities to lowland occurrences. USFS Region 1 sensitive status is proposed for *B. pedunculosum* which was found for the first time in the Region on the Forest in 1996, and current sensitive status is recommended retained for the other five species.

## ACKNOWLEDGEMENTS

Many Kootenai National Forest employees shared their data and knowledge, helped locate and survey moonwort populations, and assisted in many other ways. I give special thanks to Mike Arvidson, Terese Bielak, Annie Deuker, Leslie Ferguson, Kara Hungate, Lou Kuennen, Dan Leavell, Roy Lofts, Mike Lolley, Jon Reny, Toby Spribille, and Jack Triepke. At the Montana Natural Heritage Program special thanks go to Bonnie Heidel for coordination and technical contributions, Cedron Jones for GIS mapping, John Caratti for assistance with ecodata analysis, and Margaret Beer, Anne Dalton, Debbie Dover, and Katie Schletz for data management. Thanks are also extended to Peter Zika and Warren H. Wagner for identifying silhouette and color photocopies of the moonworts, to Larry Evans for identifying associated mushrooms, and to Joe Elliott for identifying associated mosses. This project was made possible through challenge cost-share agreements between the Kootenai National Forest and the Montana Natural Heritage Program.

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## INTRODUCTION

This report summarizes current knowledge on the distribution, ecology, and conservation status of sensitive species of moonworts (*Botrychium* spp.) on the Kootenai National Forest (KNF). It is based on information gathered in the field by KNF botanists and myself with information from the literature, from related studies in other states, and from Montana Natural Heritage Program sources. The priorities which were identified for this project were to:

- Resolve questions concerning identification, location, and population size and condition of known occurrences of sensitive *Botrychium* species
- Locate and survey new populations, and evaluate biological factors conditioning the results of fieldwork
- Characterize the habitats and microhabitats of each species
- Assess conservation status and threats to populations of each species and recommend interim management guidelines

Moonworts are primitive ferns with some of the highest chromosome numbers in the plant kingdom, which are characterized by a simple morphology but an often confounding taxonomy. The sporophyte, the conspicuous spore producing generation of the plant, is a small perennial which arises from a simple underground stem with roots which lack root hairs. The plants generally produce one aboveground leaf, or frond, per year with successive primordia enclosed in a sheath at its base. The frond is divided into two parts which share a common stalk, a usually sterile segment, the trophophore, and a fertile segment, the sporophore. The trophophore is laminar and usually pinnatifid (ternate in *B. lanceolatum*) and features of its lobing are the primary characters which distinguish the species. The sporophore bears grape-like sporangia where spores are produced. Spores germinate and develop into tiny underground gametophytes which are rarely seen or studied. Both generations of the ferns are associated with mycorrhizal fungi.

In recent years, knowledge of the diversity and distribution of moonworts has expanded at an extremely rapid pace. Nine of the fourteen moonwort species now recognized in Montana were described after 1980, and the traditional taxonomy of the group, as represented for the Pacific Northwest in Hitchcock and Cronquist (1976), has been almost completely rewritten. Even since the very recent release of the second volume of the Flora of North America, which covers the ferns and their allies, a new species, *Botrychium lineare*, has been described (Wagner and Wagner 1994), and at least two more new species are now in the process of being described (W. H. Wagner, pers. commun.). In 1996 two species of moonworts were documented for the first time in Montana; *B. pedunculosum* was found and verified (W. H. Wagner, pers. commun.) on the KNF, and a specimen collected near Columbia Falls in 1993 was identified as *B. campestre* (collected by T. Spribille, determined by W. H. Wagner).

These rapid advances have been mirrored by recent discoveries of moonworts on the Kootenai National Forest. Although a few occurrences of sensitive moonworts on the KNF were known by individual botanists (M. Arvidson, G. Heslink, pers. commun.) and a single 1971 collection labeled *B. lunaria* var. *onondagense* (annotated *B. minganense*) from the Forest was deposited at the herbarium at the University of Montana (MONTU), it was not until 1993 that any occurrences of rare moonworts documented from the Forest were recorded in the Biological Conservation Database maintained by the Montana Natural Heritage Program (MTNHP). In a recent assessment of grapeferns and moonworts of the Columbia Basin (Zika et al. 1995) a Lincoln County, MT distribution is given only for the common moonwort species *B. lanceolatum* and *B. lunaria*. There are now over 100 known occurrences, most discovered by KNF employees, of six sensitive or proposed sensitive moonwort species (U.S. Forest Service 1994, revisions pending), and additional occurrences of four non-sensitive moonworts known from the KNF.

The six moonwort species which are covered in detail in this report are *Botrychium ascendens* (upward-lobed moonwort), *B. crenulatum* (wavy moonwort), *B. minganense* (Mingan Island moonwort), *B. montanum* (mountain moonwort), *B. paradoxum* (peculiar moonwort), and *B. pedunculatum* (stalked moonwort). Also found on the KNF are four moonwort species which are considered more secure due to statewide and rangewide abundance and broad distribution; these include *B. lanceolatum* var. *lanceolatum* (triangle moonwort), *B. lunaria* (common moonwort), *B. pinnatum* (pinnate moonwort), and *B. simplex* (least moonwort). In addition to the moonworts, two additional species of *Botrychium* which are quite common on the KNF are *B. multifidum* (leathery grapefern) and *B. virginianum* (rattlesnake fern).

Most of the six sensitive or proposed sensitive species have a multi-state distribution yet are known from so few places rangewide that they are ranked globally imperilled (G2) or vulnerable (G3). This paucity of information about their distribution, as well as their species biology and ecology, underscores the need for a conservation assessment to compile all available information and to build on it.

Survey and field determination of moonworts is complicated by their species biology. They often occur in "genus communities" (Wagner and Wagner 1983), a sympatric pattern of distribution which is unexplained. They cannot be identified with certainty in their immature stages, and fronds may emerge from the ground over a three month span during favorable growing seasons, or not appear at all during unfavorable seasons. To complicate matters further, the plants are small and difficult to find even where they are common, and they are usually scarce.

The ecology of moonworts and the associated vulnerability of their populations to management activities is not well understood. Some species occupy a diversity of habitats across their range, raising questions about habitat specificity. For example, in the Storm Lake vicinity in the Anaconda Mountains, *Botrychium paradoxum* at the type locality in abundance on montane to subalpine grasslands (Vanderhorst 1993). But on the KNF where it is extremely rare, the

same species grows in western red cedar (*Thuja plicata*) and western hemlock (*Tsuga heterophylla*) habitats. Some species have been documented at sites of natural or man-made disturbance, raising questions whether moonworts are adapted to disturbance and early successional habitats (Wagner and Wagner 1993, Lellinger 1985, Lesica and Ahlenslager 1996). However, their occurrence in the stable habitats of ancient cedar groves seems to contradict this. The puzzling phenomenon of "genus communities," where species grow together in the same apparent habitat, is unique to *Botrychium* spp. and seems to run counter to the competitive exclusion principle. Keeping in mind these unique attributes of moonwort species biology and ecology, fieldwork was specially designed to address their status and assemble a reference for future conservation and biological evaluation.

The following three sections provide background on taxonomy, life history, and mycorrhizal associations which is common to all moonworts. These are followed by sections describing the methods and results and discussion of field studies on the KNF in 1995 and 1996. Information particular to each species is given in the status reviews for each of the six sensitive or proposed sensitive moonwort species on the KNF. The final section makes recommendations on status, and provides preliminary management guidelines for the conservation of these rare plants.

## CLASSIFICATION AND IDENTIFICATION

Moonworts comprise the subgenus *Botrychium* of the genus *Botrychium* in the Ophioglossaceae, a family of primitive ferns sometimes considered fern allies (Gifford and Foster 1989). The family consists of just three genera: *Ophioglossum*, *Botrychium*, and *Helminthostachys*, the first two of which occur in North America. The subfamily Botrychiodeae is sometimes recognized as a distinct family (Wagner and Wagner 1993). The genus *Botrychium* also includes the grapeferns (subgenus *Sceptridium*) and rattlesnake fern, *B. virginianum* (subgenus *Osmundopteris*), both of which are also represented in Montana. Recent molecular evidence (Hauk and Chase 1993, Hauk 1995) supports the traditional taxonomy of the group and the monophyly (descent from a single origin) of the genus *Botrychium* and each of its three subgenera. There are about 25 species of moonworts described worldwide, with 22 now described in North America (Wagner and Wagner 1993, 1994).

The taxonomy of moonworts is controversial because it is based on subtle distinctions in morphology. Disagreements on plant identification and species validity are common. Throughout this report the modern taxonomy of *Botrychium*, as presented by Wagner and Wagner (1993) in *Flora of North America*, Volume 2, is followed. The Wagners have utilized the "genus community method" (Wagner and Wagner 1983) in recognizing species. The tendency for species of *Botrychium* to grow together in mixed communities is a "natural common garden experiment" - if taxa growing together maintain consistent morphological distinctions and do not form fertile hybrids, then they are considered legitimate species.

Hybrids between species of moonworts are rare, but when found, have been determined to have abortive spores (Wagner and Wagner 1983, 1986, Wagner et al. 1984).

Molecular evidence supports the recognition of four sections within the subgenus *Botrychium*, however, placement of certain polyploid species is uncertain (Hauk 1995). There are species known from Montana from all four groups: 1) section *Lanceolatum* includes the diploid *Botrychium lanceolatum*, and the tetraploids *B. hesperium*, *B. pinnatum*, and *B. pedunculatum*, 2) section *Simplex* includes the diploids *B. montanum* and *B. simplex*, 3) section *Lunaria* includes the diploids *B. crenulatum* and *B. lunaria*, and 4) section "Campestre" includes the diploid *B. campestre*, the tetraploid *B. ascendens*, and *B. lineare* with unknown ploidy level. The tetraploids *B. minganense* and *B. paradoxum* could not be placed in sections based on molecular data. These sections are, for the most part, in agreement with those hypothesized by the Wagners based on morphological characters (Hauk 1995). Intraspecific variation in plastid DNA sequences was detected for *B. lunaria* and *B. simplex*, two widespread species, indicating the need for additional genetic research at the species and population levels to validate current concepts of species and phylogeny.

Identification of moonworts is often complicated because the species have few diagnostic characters, these characters may not be apparent in small plants, there is often a high degree of morphological variability between individuals in a population and between populations of the same species, and several species may grow together at the same site. Reliable field determination depends on the careful use of technical keys, comparison with silhouette outlines and verified specimens, and development of field experience. Taxonomic distinctions in the subgenus are based mostly on the lobing of the trophophore, but also on color, lustre, and texture of the plants and, to some degree, features of the sporophore. Accuracy of identification and documentation of moonwort populations is greatly improved by collecting voucher specimens. Since color and lustre are apparent only in live and freshly pressed plants, field notes on these characters are often necessary to identify pressed specimens. Collection guidelines and techniques for moonworts are outlined in Appendix E.

There are a number of references available to assist in identifying moonworts. The treatment of the genus in *Flora of North America* (Wagner and Wagner 1993) is the most complete guide to all but the most recently described species on this continent. In his *flora of Montana*, Dorn (1984) follows the Wagners but does not include recently described or discovered species, however, the key is simple and has useful features. For a current guide to the moonworts of western Montana, including keys to most species and pictures, consult Mantas and Wirt (1995). Lellinger (1985) includes excellent color photographs of many moonwort species. The classification in Hitchcock and Cronquist (1976) predates the treatment of the Wagners and does not recognize any of the sensitive species from Montana.



## LIFE HISTORY

Like all ferns, moonworts are characterized by alternation of generations with physiologically independent sporophytes and gametophytes. The sporophyte, the diploid (2N) generation of the plant, begins its life after fertilization of an egg by a sperm within the archegonium of the gametophyte. Embryology of moonwort species has been little studied due to the extreme difficulty of obtaining material (Gifford and Foster 1989, Mason and Farrar 1989). Early morphological studies (Campbell 1922, and citations therein) show there is diversity in patterns of embryo development among moonworts. *Botrychium simplex* has a relatively large cotyledon and rapid development, perhaps capable of maturing a small above-ground fertile frond in a year or so, while *B. lunaria* has a relatively small cotyledon and may take as many as seven years to produce an emergent frond. Sporophytes of some species, including *B. minganense* (Farrar and Johnson-Groh 1990) and *B. montanum* (Comacho 1996), can also develop vegetatively from underground propagules called gemmae, explaining the high plant densities often seen in populations of these species on the KNF. Mature moonwort sporophytes generally produce a single above ground, photosynthetic, fertile frond per growing season, but prolonged dormancy has been documented for several species (Johnson-Groh and Farrar 1993, Lesica and Ahlenslager 1996). Mature sporophytes of moonworts whose demography has been studied have been shown to be short-lived perennials, but longevity varies between species (Lesica and Ahlenslager 1996) and has not been determined for most species. In contrast, grapeferns (*Botrychium* subg. *Sceptridium*) may be quite long-lived (Kelly 1994, Montgomery 1990).

Above ground fronds of moonwort species are all fertile and bear sporangia; this is contrasted by rattlesnake-fern (*Botrychium virginianum*) which may produce vegetative fronds, a useful character for distinguishing between small plants of *B. virginianum* and the moonwort *B. lanceolatum*. The sporangia is the site of meiosis; each large eusporangia of *Botrychium* species produces thousands of haploid (1N) spores (Gifford and Foster 1989). Spores are small and lightweight enough to be carried by air currents. Even under a closed forest canopy on a calm day, when a mature moonwort sporophyte is flicked, a small cloud of yellow dust can be seen rising in the air. The effectiveness of long distance dispersal by spores helps explain the broad and often disjunct distributional patterns which are often exhibited by ferns, including moonworts (Barrington 1993, Peck et al. 1990). Dispersal of moonwort spores by droppings of small mammals has also been suggested (Zika 1992) and is consistent with observations of nibbled sporophores of some species at many KNF sites. This method of dispersal may help explain the tendency of moonworts to grow in patches and may be especially important for dispersal in forest environments with little wind. Although *Botrychium* spores were not studied, fern spores remained viable in nature for at least as long as one year, and spores on herbarium sheets germinated after over 50 years, demonstrating potential for a soil spore bank (Dyer and Lindsay 1992).

In nature, *Botrychium* spores germinate underground, and development of the haploid, non-photosynthetic gametophyte is dependent on early infection by an endophytic fungus (Bower 1926, Gifford and Foster 1989). Spore germination requires variable periods of darkness

depending on the species (Whittier 1981). Gametophytes of *Botrychium* species can be grown in sterile culture without a fungal symbiont if a suitable source of soluble sugars are supplied (Whittier 1984). *Botrychium* gametophytes are bisexual with the antheridia positioned above the archegonia (Bower 1926, Campbell 1922, Gifford and Foster 1989), facilitating self-fertilization, an advantage for colonizing following long distance spore dispersal (Peck et al. 1990). Self-fertilization may be the norm due to limited range of the flagellated sperm in the soil (Barrington 1993) and high levels of inbreeding have been demonstrated for some *Botrychium* species based on electrophoretic evidence (Soltis and Soltis 1986). However, the occurrence of interspecific hybrids which exhibit hybrid vigor may be evidence of intergametophytic crossing (Ahrensleger and Lesica 1995). Campbell (1922) reported that in *Botrychium simplex* several archegonia of a gametophyte may be fertilized at about the same time, but only one embryo was found to develop. Gametophytes with two embryos were reported for *B. lunaria*. The gametophyte, with its fungal associate, is thought to nourish the young embryonic sporophyte (Comacho 1996). The longevity of gametophytes and their fate following maturation of an associated sporophyte has not been reported. Some moonwort species are distinguished by having the gametophyte remaining attached to the mature sporophyte (Wagner and Wagner 1981).

## MYCORRHIZAL RELATIONS

All *Botrychium* species are believed to be obligately dependent on mycorrhizal relationships in both the gametophyte (Bower 1926, Campbell 1922, Gifford and Foster 1989, Scagel et al. 1966, Schmid and Oberwinkler 1994) and sporophyte generations (Bower 1926, Gifford and Foster 1989, Wagner and Wagner 1981). The gametophyte is subterranean and achorophyllous, depending on an endophytic fungus for carbohydrate nutrition, while the roots of the sporophyte lack root hairs and probably depend on the fungal symbiont for absorption of water and minerals (Gifford and Foster 1989). *Botrychium* gametophytes were considered saprophytic (Bower 1922), but are now thought to obtain carbohydrates fixed by neighboring plants and transported by shared mycorrhizal fungi (Camacho 1996); they are thus better classified as myco-heterotrophic (Leake 1994). The gametophytes cannot utilize complex carbohydrates (starch, cellulose etc..) but can be grown in sterile culture without a fungus if they are supplied with a source of soluble sugars (Whittier 1984). In nature, a fungal associate is present within the plant at the earliest stages of development of the gametophyte and sporophyte (Bower 1926). In the gametophyte, fungal infection is confined to the interior of the prothallus; areas of apical growth and the sexual organs are left uninfected (Bower 1926, Campbell 1922). There are no reports of successful completion of the lifecycle by *Botrychium* species without fungal infection, however, the degree of infection may vary between species and age of plants (Bower 1926, Campbell 1922).

Little is known about the mycorrhizal fungi associated with *Botrychium* species other than their presence within the gametophyte and roots of the sporophyte (Camacho 1996). The species are unknown and may be undescribed. *Botrychium* mycorrhizae have been described as the vesicular-arbuscular (VAM) type (Berch and Kendrick 1982, Schmid and Oberwinkler



1994), however, preliminary results of recent investigations suggest there are unique features of the system (Camacho 1996). VAM fungi are thought to be obligate symbionts and have never been axenically cultured, and are thus extremely difficult to study and identify (Comacho 1996). There is as yet nothing known about their symbiotic specificity or habitat requirements.

The mycotrophic condition is important to the ecology of *Botrychium* species in several ways. Heterotrophic life stages may include gametophytes, young sporophytes, dormant sporophytes, and gemmae (Camacho 1996). Nutrition supplied through a fungal symbiont may allow the ferns to withstand repeated herbivory or prolonged dormancy (Kelly 1994, Montgomery 1990) and growth in dense shade, and may have allowed the evolution of a species, *B. paradoxum*, whose sporophyte lacks a sterile lamina and is presumed to have reduced photosynthetic capacity (Wagner and Wagner 1981). Specificity of the fungal/fern relationship has implications for the occurrence of genus communities, the distribution of the species across the landscape, and associations with particular vascular plants. Mycorrhizal links may explain the often observed close associations between certain moonworts and strawberries (Vanderhorst 1993, Zika 1992, 1994) and between grapeferns (*Botrychium* subgenus *Sceptridium*) and Rosaceous fruit trees (Lellinger 1985). Due to the occurrence of heterotrophic life stages, moonworts share many of the morphological and habitat characteristics of myco-heterotrophic plants such as orchids and monotropids (reviewed by Leake 1994) and in many respects behave much like mushrooms (Zika 1994).

## METHODS

Prior to fieldwork in 1995, the Biological Conservation Database (BCD) maintained by MTNHP was queried for known occurrences of sensitive *Botrychium* species on the KNF. There were nineteen records in the database, 1 of *Botrychium ascendens*, 3 of *B. crenulatum*, 10 *B. minganense*, 3 of *B. montanum*, and 2 of *B. paradoxum*. Kootenai National Forest botanists and other knowledgeable local individuals were interviewed to obtain leads on other possible moonwort sightings which were not entered in the database. The herbaria at the University of Montana (MONTU) and Montana State University (MONT) were searched for collections of moonworts from the KNF; only one specimen from the KNF area was found at MONTU, a collection labeled *B. lunaria* var. *onadogense* (the poorly pressed specimen has been tentatively determined to be *B. minganense*).

Unresolved questions were compiled and populations were relocated to resolve them. Special attention was given to the globally rare species originally treated in Category 2 by the U.S. Fish and Wildlife Service: *Botrychium ascendens*, *B. crenulatum*, and *B. paradoxum*, whose occurrences on the KNF represented significant range extensions in Montana and whose identities remained unverified. High priority was also given to relocating reports of moonworts not identified to species. When occurrences were relocated the populations were surveyed and mapping was checked for accuracy. To obtain reliable species determinations, the plants were keyed out in the field, close-up photographs (35 mm slides) of the plants were taken, and whenever population numbers allowed, specimens were collected in accordance with guidelines established by the Montana Native Plant Society (1993) with special amendments for *Botrychium* species (Appendix E). Kootenai National Forest botanists from all districts were contacted and encouraged to collect specimens as appropriate when they revisited known populations or located new occurrences. At the end of the 1995 season, all specimens were photocopied (black and white), and these "silhouettes" were sent for determination by Peter Zika (Oregon Natural Heritage Program), a botanist who has worked extensively with moonworts. Color photocopies of selected problematic 1996 collections were also sent to Warren H. Wagner (University of Michigan) for determination. All collections will be deposited at the herbarium of the University of Montana (MONTU). Many Forest Service collections will remain at the KNF herbarium at the Supervisors Office in Libby.

Methodology to address the second established priority, *de novo* searches and determination of habitat breadth, included several strategies. Aerial photographs of known population sites were used to locate nearby similar habitats and altered habitats (e.g. clearcuts and second growth stands) to be searched. Searches were also conducted in alternate habitats as they were located on the ground; for example, deciduous thickets adjacent to known moonwort populations in forested habitats and vice-versa were searched. Since most known moonwort occurrences on the KNF were in mature cedar stands, a list of old-growth cedar stands (L. Kuennen, pers. commun.) was used to select areas to be searched to test the predictability of moonworts occurring in these habitats. Additional moist habitat types where moonworts have been found elsewhere (e.g. meadows and aspen stands) were searched when they were

encountered. An attempt was made to cover the diversity of moist habitats throughout the KNF. Moonwort surveys involved deliberate and lengthy searches, the time devoted depending on the habitat. Thus, cedar types with little ground cover required less time than types with heavy shrub, forb, or moss cover. A listing of areas and habitats which I searched is given in Appendix A.

The composition of genus communities was studied to assess relative abundance, conservation status, and relationships between sensitive and non-sensitive moonwort species. Sites known to harbor single species were thoroughly searched for occurrences of other more cryptic species. Individuals of each species were censused and microsite differences were noted whenever genus communities were encountered.

Ecodata methodology was utilized to characterize the habitats of each of the sensitive *Botrychium* species on the KNF. Standard forms, including general field, location linkage, and plant composition (U.S. Forest Service 1992) were completed for 27 1/10 acre plots. Sampling included all *B. ascendens* and *B. paradoxum* occurrences and representative occurrences of *B. crenulatum*, *B. minganense*, *B. montanum* and *B. pedunculosum*. In a few cases plot locations are best approximations of where moonwort taxa were seen in past years (*B. crenulatum* at Swamp creek., *B. paradoxum* at two Can Creek sites). Most large populations and significant genus communities were sampled. The plots include occurrences of *B. lanceolatum* and *B. pinnatum* in association with the sensitive species. An attempt was made to sample across the geographic and ecological range of the species on the Forest, but a few habitats were neglected, most notably, the roadside and reported subalpine habitats of *B. crenulatum* on the Fortine District, and *Abies lasiocarpa* and *A. grandis* habitats of *B. minganense* on the Libby District. An Ecodata plot was also taken at a clearcut adjacent to a moonwort genus community at Red Top Creek.

The Ecodata was analyzed using the Strata program on the Data General System. A strata was created for each of *Botrychium ascendens*, *B. crenulatum*, *B. minganense*, *B. montanum*, *B. paradoxum*, and *B. pedunculosum*. Plots were assigned to more than one strata if they were genus communities with more than one sensitive species; thus the sets are not mutually exclusive. The plot in a clearcut at Red Top Creek was not included in the analysis. Strata produces synthesis tables of site physical data and plant composition, tables of averages and standard deviations of continuous site variables, tables of constancy and abundance of discrete site variables and plant species composition, tables of diversity and dominance for each plot and strata, and tables of similarity between plots, between strata and individual plots, and between strata. The indices of dominance calculated by Ecodata were inconsistent between runs using the same data and should be ignored.

To study *Botrychium* microhabitats at two sites, including a population of *Botrychium crenulatum* at Alexander Mountain and a *Botrychium* genus community at Zulu Creek, randomized replicated microplots (U. S. Forest Service 1992) within standard Ecodata plots were sampled in 1995 to compare with microplots selected for the presence of moonworts.

This data is included in Appendix C. The data was statistically analyzed using correlation matrices and analysis of variance (ANOVA) and although a few significant associations were found at Zulu Creek, the methodology was deemed inappropriate because assumptions of randomness were not met (L. Crone, pers. commun.) and the time consuming procedure was not continued in 1996.

In 1996, we enlisted the assistance of other specialists to identify associated mosses and mushrooms. This information further characterizes habitat, and the patterns of association with fungi may provide clues in symbiosis. Collections of mosses and fungi were taken from the immediate microhabitats of moonworts from chosen significant communities representing a range of species and habitat types. Joe Elliott (Helena, MT) collected and identified mosses from 5 sites (Kelsey Creek, Zulu Creek, Alexander Mountain, Houghton Creek, and West Fisher Creek) on July 29 and 30. Larry Evans (Missoula MT) collected and identified mushrooms from four sites (Sutton Creek, Alexander Mountain, Kelsey Creek and French Creek) on September 23 and 24. Both of these researchers also identified moss and fungi collections taken from several other *Botrychium* sites by myself and KNF employees in 1995 and 1996.

Also in 1996, two graduate students incorporated *Botrychium* material from the KNF into their research. Living samples of *B. montanum* with root substrate were collected from two sites and mailed overnight to Francisco Comacho (Dept. of Botany and Plant Pathology, Oregon State University, Corvallis) for isolation, description, and identification of mycorrhizal fungi and moonwort vegetative propagules. Linda Swartz (Dept. of Forestry, University of Idaho) visited the KNF and collected leaf samples of *B. minganense* and *B. crenulatum* for morphological and DNA analysis.

Permanent belt transects as described by Lesica (1987) were established at French Creek both within a proposed logging unit and nearby outside the unit to monitor phenology and demography of *Botrychium minganense* and *B. montanum*. Individual plants were identified, measured, and mapped on a grid within plots in mid-July and again in early September 1995 and 1996. Three Rivers District botanist Leslie Ferguson, and biological technicians Mike Arvidson and Laura Sedler helped establish the plots and/or collect data and are aware of the locations. Further details on establishment and raw data from both years are attached as Appendix D.

## RESULTS AND DISCUSSION

**Summary Statistics:** There are now a total of 104 known occurrences of six sensitive or proposed sensitive *Botrychium* species in or, in a few cases, adjacent to the Kootenai National Forest (Table 1). Thirty-four of these were 1996 discoveries and at least 30 were observed for the first time in 1995. Many more are verifications or species determinations of reports that had not been included in the Biological Conservation Database prior to 1995. There are now more than five times the number of occurrences documented as there was in 1995 before this project began. *Botrychium pedunculosum*, a former C2 species, was documented in 1996 for the first time in Montana at five sites on the KNF and is proposed for listing as sensitive in Region 1. Three sites have been documented with *Botrychium ascendens*, a former C2 species which was reported but not verified from the KNF before 1995, but one of these populations was probably extirpated by floods in 1996. Two occurrences of *B. paradoxum*, another former C2, consisting of a single plant each, were observed in 1993, and a 1995 collection of a third occurrence verified the species on the KNF, but none of these have been relocated in years subsequent to their discovery despite exhaustive surveys in both of the last two years.

Table 1. Occurrences of Sensitive and proposed Sensitive *Botrychium* species on the Kootenai National Forest. New occurrences are those not in the BCD prior to 1995.

Species/District*	D1	D3	D4	D5	D7	Total/New
<i>B. ascendens</i>		1		2		3/3
<i>B. crenulatum</i>	2	8	1	4	1	16/13
<i>B. minganense</i>	5	4	27	16	1	53/43
<i>B. montanum</i>	3	1	14	5	1	24/21
<i>B. paradoxum</i>			3			3/1
<i>B. pedunculosum</i>	4		1			5/5
Total	14	14	46	27	3	104/86

\*D1 = Rexford, D3 = Fortine, D4 = Three Rivers, D5 = Libby, D7 = Cabinet.

**Genus Communities:** A total of at least 25 sites were found on the KNF which harbor more than one species of moonwort (Table 2). These sites represent over half of the total number of sensitive moonwort occurrences on the Forest, including all occurrences of the rarest species *Botrychium ascendens*, *B. paradoxum*, and *B. pedunculosum*. The relative rarity of the sensitive species on the KNF is reflected both by number of occurrences and by number of individuals in populations. *Botrychium minganense* and *B. montanum* are the most common co-occurring species pair. The species most commonly occurring by themselves are *B. crenulatum* (13 of 17 occurrences) and *B. minganense* (31 of 53 occurrences). Rattlesnake fern (*B. virginianum*) is present in most, but not all, genus communities.

Table 2. Moonwort genus communities on the KNF.

Site\Species*	as	cr	la	mi	mo	pa	pe	pi	vi
Arbo Ck.				20	1				
Beaver Ck.	6	100							x
Beetle Ck.			x	45	26				x
Big Ck.			13	10			5		x
Big Ck. SF			10	45	45		8		x
Can Ck.				120	150	2			x
Cedar Ck.				17	15				x
Clay Mt.			x		13				
French Ck.				53	241				x
Houghton Ck.	5			?	1				x
Keeler Ck.			10		1		3		
Kelsey Ck.				57	95				
Meadow Ck. NF			x	37	18				
Mt. Baldy				x	x				
Parsnip Ck.			35	40	20		1		x
Pete Ck.			10	5					x
Poorman Ck.			4	8					
Redtop Ck.			3	150	50			200	
Rock Ck.		?	x						x
Sterling Ck.				20	100				
Sutton Ck.		?	1	100	35		1	2	x
Swamp Ck.		8		1					x
Turner Ck.				19	4				
W. Pipe Ck.				6	43				x
W. Fisher Ck.	6			5					x
Zulu Ck.				65	6	1		1	x

\* as=*Botrychium ascendens*, cr=*B. crenulatum*, la=*B. lanceolatum*, mi=*B. minganense*, mo=*B. montanum*, pa=*B. paradoxum*, pe=*B. pedunculatum*, pi=*B. pinnatum*, vi=*B. virginianum*. Numbers are population estimates for each site in the same year. x = presence ? = uncertain identification.

**Habitat characterization:** The results of two years of extensive surveys suggest that individual moonwort species occupy a relatively narrow range of habitats on the KNF. All known habitat types for each species are listed in Table 3. *Botrychium ascendens* was found and verified only from alder (*Alnus*) thickets and a spruce (*Picea*) habitat with alder. *Botrychium crenulatum* was found mostly in open habitats with calcareous substrates (wetlands, openings, and roadsides). *Botrychium minganense*, *B. montanum*, and *B. paradoxum* were found mostly in maturing to old growth western red cedar (*Thuja plicata*) and western hemlock (*Tsuga heterophylla*) habitats. *Botrychium pedunculosum* was found only in old floodplain channels in old growth western red cedar stands. No moonworts were found in recent clearcuts or stands of young regeneration but *B. minganense* and *B. montanum* were found in maturing second growth cedar. *Botrychium minganense* has the broadest ecological and geographical amplitude. Unlike the moonworts, the larger *Botrychium* species, *B. multifidum* (leathery grapefern) and *B. virginianum* (rattlesnake fern), were found in relatively recently logged areas.

Table 3. Documented habitat types of sensitive *Botrychium* species on the Kootenai National Forest. Types are listed in descending order of number of occurrences. Major types are in bold. Habitat types are described in Cooper et al. (1991), Pfister et al. (1977), and/or Hansen et al. (1995).

SPECIES	HABITAT TYPES
<i>B. ascendens</i>	<i>Alnus sinuata</i> , <i>Picea/Cornus stolonifera</i>
<i>B. crenulatum</i>	roadsides and old roadways, <i>Picea/Cornus stolonifera</i> , <i>Alnus sinuata</i> , subalpine rock outcrops, <i>Picea/Cornus stolonifera</i> (seral aspen), <i>Thuja plicata/Clintonia uniflora</i> ?
<i>B. minganense</i>	<i>Thuja plicata/Oplopanax horridum</i> , <i>Thuja plicata/Clintonia uniflora</i> , <i>Tsuga heterophylla/Clintonia uniflora</i> , <i>Thuja plicata/Athyrium filix-femina</i> , <i>Alnus sinuata</i> , <i>Abies lasiocarpa/Clintonia uniflora</i> , <i>Abies grandis/Clintonia uniflora</i> , <i>Picea/Cornus stolonifera</i> (including seral aspen), <i>Agrostis stolonifera</i> grazing disclimax
<i>B. montanum</i>	<i>Thuja plicata/Clintonia uniflora</i> , <i>Thuja plicata/Oplopanax horridum</i> , <i>Tsuga heterophylla/Clintonia uniflora</i> , <i>Thuja plicata/Athyrium filix-femina</i> , <i>Alnus sinuata</i>
<i>B. paradoxum</i>	<i>Tsuga heterophylla/Clintonia uniflora</i> , <i>Thuja plicata/Clintonia uniflora</i>
<i>B. pedunculosum</i>	<i>Thuja plicata/Oplopanax horridum</i> , <i>Thuja plicata/Athyrium filix-femina</i>



Negative results (Appendix A) can be used to roughly indicate the probability of sensitive *Botrychium* species occurring in broad categories of seral stages and habitat types. I found sensitive moonworts in 63% (27/43) of the old growth cedar and hemlock stands, 19% (3/16) of the second growth cedar and hemlock stands with closed canopies, 0% (0/7) of the recent cutting units with cedar or hemlock potential, 25% (2/8) of the alder thickets, and 14% (1/7) of the moist meadows which were searched. These figures should be viewed cautiously because searches were biased towards cedar and hemlock habitat types and were not random.

Results of the Ecodata analysis using Strata are presented in Appendix C. Included are synthesis tables of site physical data and plant composition, tables of averages and standard deviations of continuous site variables, tables of constancy and abundance of discrete site variables and plant species composition, tables of diversity for each plot and strata, and tables of similarity between plots, between strata and individual plots, and between strata. Note: indices of dominance calculated by Strata were inconsistent between runs using the same data and should be ignored. Habitat variables for each sensitive *Botrychium* species are discussed in the six status reviews which follow this section.

Analysis of Ecodata and analysis of moonwort genus community composition (Table 2) reveal two main *Botrychium* species groups with similar habitats on the KNF. The larger group, which includes *B. lanceolatum*, *B. minganense*, *B. montanum*, *B. paradoxum*, *B. pinnatum*, and *B. pedunculatum*, occurs mostly in forest habitats with high canopy cover by trees, relatively low understory cover and usually heavy litter layers. A smaller group made up of *B. ascendens* and *B. crenulatum* occurs mostly in deciduous wetlands. Habitat and geographic distribution of species appear to be correlated, with the forest dwelling species more common in the western part of the KNF, while the species of deciduous wetlands are more common in the eastern part. The most common forest species, *B. minganense* and *B. montanum*, in a few cases grow with *B. ascendens* or *B. crenulatum* in the eastern part of the Forest. In these instances, their numbers are very low, and the habitats are deciduous wetlands.

**Associated mushrooms and mosses:** Larry Evans identified fruiting bodies of 63 taxa of fungi associated with one or more sensitive *Botrychium* species on the KNF (Appendix F). The summer of 1996 was dry and few mushrooms were up throughout western Montana, but rains in September allowed development of some by the survey date. In western red cedar and western hemlock habitat types there was a noticeably higher diversity of mushrooms in moonwort habitats than in surrounding habitat without moonworts. This is most likely a shared requirement for moist microhabitats, but could also be related to low levels of root zone competition, substrate characteristics, or mycorrhizal relationships. At Kelsey Creek, 29 mushroom taxa were identified, approaching in number the 35 vascular plants identified in an Ecodata plot at the same site. Since many species of fungi do not produce mushrooms or produce them rarely, or only in spring or summer, the diversity of fungi associated with moonworts is expected to be much higher than two days of survey indicate.



Of the fungi identified, the genera *Cortinarius*, *Hebloma*, *Hygrophorus*, *Russula*, and *Suillus* are known to be mycorrhizal with conifers, while the rest are saprophytic or parasitic (L. Evans, pers. commun., Aurora 1986). Two mycorrhizal species, *Hygrophorus eburneus* and *Suillus sibericus* (or *S. umbonatus*) were observed in direct contact with moonworts (see slide #17 in Appendix I). The identity of the fungal symbionts of moonworts are unknown (see below, and the preceding section on mycorrhizal relations), and the existence of mycorrhizal links between moonworts and conifers is merely speculative.

Joe Elliott identified 28 taxa of mosses from 24 sites on the KNF with sensitive *Botrychium* species (Appendix G). Typically, the mosses are species adapted to decomposing duff and organic soils with high moisture levels. The closest and most consistent group of moss associates are the leafy mosses in the Mniaceae (*Mnium*, *Plagiomnium*, and *Rhizomnium* spp.). *Plagiomnium insigne*, which appears to be an especially common moss associate, was collected from six sites distributed across the KNF with several sensitive *Botrychium* species of both forests and alder thicket openings. Two species, *Brachythecium asperimum* and *Bryum pseudotriquetrum* were found in the alder habitats of both *Botrychium ascendens* and *B. crenulatum*, but were not collected from forested habitats of other sensitive moonwort species. Several associated mosses are West Coast endemics with eastern-most distributions including only habitats of western Montana most strongly influenced by Pacific-maritime climatic patterns. *Plagiomnium venustum*, *Plagiomnium insigne*, *Eurhynchium oreganum*, *Rhizomnium nudum*, *Rhytidiopsis robusta* and *Brachythecium asperimum* are restricted to the warmest, most humid habitats in northwestern Montana (Vitt et. al. 1988, Schofield 1992, and Lawton 1971).

**Mycorrhizae and vegetative propagules:** Francisco Camacho (pers. commun.) isolated 9 taxa of fungi and 2 taxa of bacteria from sterilized roots of *Botrychium montanum* and found evidence of vegetative reproduction in plants of this species sent to him from the KNF. The identities of the fungi have not yet been determined and it is probable that some of the fungi may be undescribed species. Some of the more abundant fungi within the roots from the KNF are similar to fungi extracted from *B. montanum* and *B. pumicola* from other locations.

Evidence of vegetative reproduction was deduced by the presence of 10 immature underground sporophytes without attached gametophytes found in close proximity to a mature sporophyte. No gemmae or gametophytes were found associated with the plants from the KNF, but were found in samples of *B. montanum* from other locations. It is possible that KNF plants are reproducing by gemmae and these had disappeared by the sampling date, or that they are reproducing by some other form of root fragmentation.

**French Creek monitoring transects:** Two years' results of intraseasonal monitoring of *Botrychium minganense* and *B. montanum* at French Creek (Table 4) show that the phenology of frond emergence in these populations is staggered across the growing season and that there are considerable levels of herbivory. Between July and September in both years fronds of both species disappeared and new fronds of both species emerged. Actual population size was larger than was apparent at either one date. The appearance and disappearance of fronds

within a season does not necessarily represent recruitment and mortality, but indicates a variable phenology of leaf development and senescence or predation. Fronds appearing late in favorable growing seasons are consistent with season long dormancy documented for sporophytes of *Botrychium* species (Johnson-Groh and Farrar 1993, Lesica and Ahlenslager 1996, Montgomery 1990). Nibbled plants of both species, including plants nibbled to ground level, were observed at the later dates indicating that herbivory was the likely mechanism for fronds disappearing. Individual plants which were mapped on both dates in the same season were generally taller or nibbled on the second date (Appendix D).

Table 4. Summary of intraseasonal population monitoring results at French Creek, transects 1 and 2.

	<i>B. minganense</i>		<i>B. montanum</i>	
	1995	1996	1995	1996
# fronds July	16	16	177	107
# disappeared	8	2	96	56
# new	7	2	64	48
# fronds September	15	16	145	99
# nibbled	5	8	13	34
total fronds	23	18	241	155

Data from two years is not adequate to document mortality and recruitment in the populations, but some interesting trends are apparent. The fate of individual plants was tracked over the monitoring period by assigning each plant a letter code (Appendix D). High densities of *B. montanum* in transect 1 in 1995 made reliable analysis difficult, so only the moderate density plots 2 and 3 from this transect were used for this analysis. Individual plants were observed at almost every possible permutation of the four dates.

Table 5 summarizes data from the three transects in both years. There were fewer fronds of *B. montanum* in transect 1 and fewer fronds of *B. minganense* in transect 2 in 1996 than in 1995. However, there were higher numbers of *B. montanum* in transect 2, and higher numbers of *B. minganense* in transect 3 in 1996. Transect 2 is located in relatively wet ground below a seep while transect 1 is in dryer ground above the seep. *Botrychium montanum* was the only moonwort in transect 1 in both years. In 1995, transect 2 contained mostly *B. minganense*, but the proportion of *B. montanum* increased dramatically in 1996. These results suggest that *B. montanum* is adapted to somewhat dryer microhabitats; this conclusion is also supported by observations of the two species elsewhere on the KNF. These results also show that populations (and genus communities) are not homogenous; some

observations of the two species elsewhere on the KNF. These results also show that populations (and genus communities) are not homogenous; some areas (or species) may have increased numbers of emergent fronds while other areas (or species) have decreased numbers over the same period. These differences are an indication of interactions between the individual species with climate and microhabitat.

Table 5. Summary results of two years of monitoring of *Botrychium minganense* and *B. montanum* at French Creek, Transects 1, 2 (plots 2 and 3 only), and 3.

	<i>B. montanum</i>		<i>B. minganense</i>	
transect #	1	2	3	
# fronds 1995	41	6	23	32
# disappeared	23	5	14	7
# new	7	12	9	9
# fronds 1996	25	13	18	37

**Status Reviews:** The Status Reviews for each of the six sensitive or proposed sensitive *Botrychium* species which follow this section further summarize the results of the surveys and provide pertinent information from other sources particular to each species. Included are sections on classification, formal status, description, geographical distribution, habitat, population demography and biology, land ownership, and management considerations. Throughout the remainder of this report occurrences of sensitive moonworts are referred to by their site names and three digit element occurrence numbers assigned in the Biological Conservation Database. These reference the Element Occurrence Records (EORs) and topographic maps in Appendix B which give precise location and other details for each occurrence. Indices to the EORs by KNF districts and by species are included at the beginning of Appendix B.

Upward-lobed Moonwort  
*Botrychium ascendens*

A. CLASSIFICATION

1. FAMILY: Ophioglossaceae, a family of primitive ferns
2. GENUS: *Botrychium* subgenus *Botrychium*
3. SPECIES: *Botrychium ascendens* Wagner, described in Wagner and Wagner (1986).

B. PRESENT LEGAL OR OTHER FORMAL STATUS

1. FEDERAL STATUS

- a. U.S. FISH AND WILDLIFE SERVICE: Previously recognized as C2 (U.S. Fish and Wildlife Service 1993), indicating that it is a species "for which information now in the possession of the Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which sufficient data on biological vulnerability and threat are not currently available to support proposed rules." Recognition of C2 species was officially discontinued by the Service in 1996 (U.S. Fish and Wildlife Service 1996).
  - b. U.S. FOREST SERVICE: Sensitive in Region 1 (U.S. Forest Service 1994a).
  - c. BUREAU OF LAND MANAGEMENT: none.
2. STATE: The Montana Natural Heritage Program ranks the species G3? and S1 (Heidel 1996). Global rank of G3 signifies vulnerability to extinction throughout its range; the state rank S1 signifies that it is critically imperiled because of extreme rarity in Montana.

C. DESCRIPTION

1. GENERAL NONTECHNICAL DESCRIPTION: The sporophyte produces a single above ground frond per year which is divided into two segments, a mostly sterile trophophore and a fertile sporophore, which share the same stalk. The frond stands up to 8" above ground but is usually smaller and is a bright yellow-green color. The trophophore is pinnatifid with as many as 10 pairs of pinnae, which are strongly upswept away from the base, so that the upper angle between the axis and the pinnae is much smaller than the lower angle. The upper margins of the pinnae are usually divided into narrow teeth-like or saw-like segments, or the pinnae are deeply incised. Often there are sporangia (spore bearing bodies) born on the margins of the lower pinnae of the sterile leaf segment. The fertile segment, when mature, is longer than

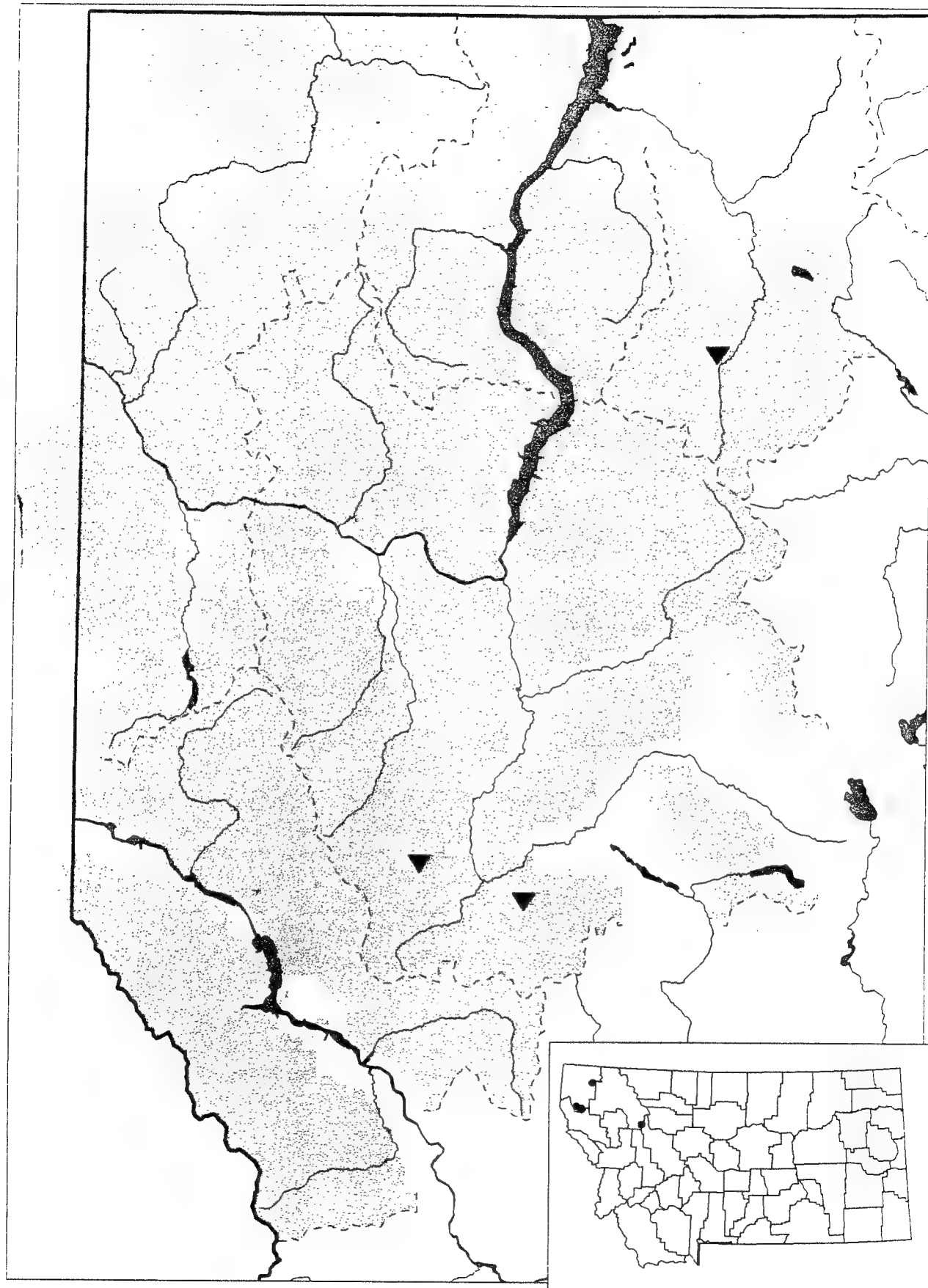
the sterile segment and is branched, the branches bearing grape-like sporangia which contain the spores; when mature they release the spores, which appear as a yellow dust. The inconspicuous and rarely seen gametophyte grows underground.

2. TECHNICAL DESCRIPTION: "Trophophore stalk 3-10 mm, 1/6 length of trophophore rachis; blade yellow-green, oblong to oblong-lanceolate, 1-pinnate, to 6 X 1.5 cm, thin but firm. Pinnae to 5 pairs, strongly ascending, well separated, distance between 1st and 2d pinnae not or slightly more than between 2d and 3d pairs, basal pinnae pair approximately equal in size and cutting to adjacent pair, obliquely narrowly cuneate, undivided to tip, margins sharply denticulate and often shallowly incised, apex rounded, venation like ribs of a fan, midrib absent. Sporophore 2-pinnate at base of sporangial cluster, 1.3-2 times length of trophophore.  $2n = 180$ ." from Wagner and Wagner (1993).
3. LOCAL FIELD CHARACTERS: On the KNF, *Botrychium ascendens* is known to grow with *B. crenulatum* and *B. minganense* and is similar in appearance to both. It can be distinguished from both by its strongly ascending pinnae with sharply serrate or incised margins, vs. the others' usually spreading pinnae with entire to crenulate margins. It differs from *B. minganense* by its bright yellow-green vs. deep, dull green color and by its thinner blade texture. Although *B. ascendens* is reported as the only moonwort species to commonly have sporangia on the proximal pinnae of the trophophore (Wagner and Wagner 1986, 1993, Mantas and Wirt 1995), this condition has also been observed in *B. crenulatum*, *B. minganense*, *B. montanum*, and *B. pedunculosum* on the KNF, and Zika (1992) also reports it for *B. lanceolatum* and *B. pinnatum* in Oregon.

#### D. GEOGRAPHICAL DISTRIBUTION

1. RANGE: North America: Alberta, British Columbia, Ontario, Yukon Territory, Alaska, California, Montana, Nevada, Oregon, Wyoming (Wagner and Wagner 1993); in addition it is recently reported in Idaho (Idaho Conservation Data Center, pers. commun.) and Washington (Washington Natural Heritage Program, pers. commun.).
2. MONTANA DISTRIBUTION: Prior to 1995, *B. ascendens* was reported from two locations in the state. A specimen from one site in Lewis and Clark County in the Bob Marshall Wilderness is cited in the description of the species (Wagner and Wagner 1986). The other report, in Lincoln County on the KNF (Can Creek), is not represented by a specimen and after revisiting the site, it is believed to have been based on misidentified plants of *B. minganense* or *B. montanum* and has been deleted from the Biological Conservation Database. Three populations were found on the KNF in 1995, bringing the state total to four occurrences. The known distribution of the species in Montana is shown on the inset of Figure 1.

**Figure 1. *Botrychium ascendens* -- Upward-lobed Moonwort**  
Occurrences on or near the Kootenai National Forest, Montana



### 3. KOOTENAI NATIONAL FOREST OCCURRENCES

- a. **CURRENT SITES:** *B. ascendens* was found and verified on the KNF for the first time in 1995. Two sites were located by Jon Reny and Terese Bielak on the Libby District at West Fisher Creek (002) and Houghton Creek (004) and one by myself at Beaver Creek (003) in a state school section surrounded by the KNF on the Fortine District. Collections were made from all populations and photocopy silhouettes of those from Beaver Creek and Houghton Creek were verified by Peter Zika (pers. commun.). The West Fisher Creek population is believed to have been extirpated by spring floods in 1996. The Houghton Creek population was relocated in 1996. Figure 1 shows the approximate locations of these four populations. Element Occurrence Records and maps showing the precise locations are given in Appendix B.
- b. **UNVERIFIED/UNDOCUMENTED REPORTS:** The reported occurrence of *Botrychium ascendens* at Can Creek is now believed to have been based on a misidentification and has been removed from the Biological Conservation Database. The specimen from West Fisher Creek (002) could not be identified by P. Zika (pers. commun.), however, the collector observed additional plants at the site, is familiar with the species, and differentiated them from *B. minganense* at the same site (T. Bielak, pers. commun.); in addition the habitat is similar to the nearby Houghton Creek site.
- c. **AREAS SURVEYED BUT SPECIES NOT LOCATED:** see Appendix A for a listing of areas which were searched.

#### E. HABITAT

1. **ASSOCIATED VEGETATION:** At its type locality in the Wallowa Mountains in Oregon where it is most abundant *Botrychium ascendens* grows in mesic to moist meadows in the *Picea engelmannii* zone (Wagner and Wagner 1986, Zika 1992, 1994). In Idaho and Washington it is reported from western red cedar (*Thuja plicata*), subalpine fir (*Abies lasiocarpa*), and alpine meadow habitats (Idaho Conservation Data Center, Washington Natural Heritage Program, pers. commun.).

On the KNF *Botrychium ascendens* is associated with shrub or conifer dominated wetlands. At Beaver Creek the plants grow in a small opening in second growth *Picea/Cornus stolonifera* habitat (Hansen et al. 1995) with relatively low tree, shrub, and forb cover and heavy ground cover by mosses. The Libby District sites have insignificant tree cover, but high cover of shrubs and wet-site forbs and ferns. They are probably best classified as *Alnus sinuata* habitat types (Cooper et al. 1991, Hansen et al. 1995).

Vegetation was sampled by Ecodata (Appendix C) at all known KNF sites although data from West Fisher Creek represents post flood conditions. *Picea*, the only well represented tree, was present only at Beaver Creek. Shrubs have moderate to heavy cover (20-80%). Well represented shrubs in one or more plots include *Acer glabrum*, *Alnus incana*, *Alnus sinuata*, *Cornus stolonifera*, *Rhamnus alnifolia*, *Rubus parviflorus*, and *Symphoricarpos albus*. Grasses are scarce, but *Elymus glaucus* is constant. Forbs contribute significant cover (20-80%) but no single species is well represented. Forbs constant in the plots include *Aralia nudicaulis*, *Fragaria virginiana*, *Geum macrophyllum* and *Smilacina stellata*. The grapefern *Botrychium virginianum* and horsetails *Equisetum arvense* and *E. hymale* are constant. Moss cover is heavy (70-80% cover) at Beaver Creek and Houghton Creek. Mosses immediately associated with *Botrychium ascendens* include species of *Bryum*, *Brachythecium*, and *Plagiomnium* (Appendix G).

Vegetation at all KNF sites is effected by high water tables and flooding events. Scouring and deposition of gravel, caused by flooding at West Fisher Creek in 1996 eliminated nearly all moss cover and is believed to have extirpated the population of *B. ascendens*, but cover by flood resistant shrubs and forbs remained very high. The Houghton Creek site, which was not subject to catastrophic floods in 1996, retains heavy cover by mosses. Suitable habitat for *B. ascendens* is likely to be temporary. The small meadows where *B. ascendens* grows in Oregon are also believed to be temporary phenomena subject to reforestation (Zika 1994).

At Beaver Creek *Botrychium ascendens* grows with *B. crenulatum*, at West Fisher Creek it grew with *B. minganense*; and at Houghton Creek it grows with *B. montanum*. Throughout its range it has also been found with *B. lunaria*, *B. pinnatum* and *B. simplex* (Wagner and Wagner 1986, Zika 1992).

Analysis of Ecodata using Strata shows that the vegetation of *Botrychium ascendens* sites on the KNF shares many attributes with that of *B. crenulatum* sites (Appendix C). These two strata have relatively high indices of diversity, reflecting high shrub, forb, fern, and moss cover by a large number of species. In contrast, other sensitive moonworts on the KNF usually grow in habitats with high canopy cover by conifers (mostly *Thuja plicata*) and depauperate middle and lower vegetation layers.

Vegetation is described in further detail in the general site description fields of the Element Occurrence Records in Appendix B and in the Ecodata tables in Appendix C. Photographic slides of the vegetation at Beaver Creek and Houghton Creek are included in Appendix I.

2. TOPOGRAPHY: The sites on the KNF are in glaciated valley stream floodplain bottoms in the eastern part of the Forest. Elevations range from 3,180 to 3,850 feet. At West Fisher Creek the plants grew on hummocks above the saturated floodplain



bottom, while at Beaver Creek they grow in a concave swale. The sites are level to gently sloping.

3. **SOIL RELATIONSHIPS:** The soils have alluvial parent materials and are subject to seasonal inundation and periodic perturbation by catastrophic floods. At West Fisher Creek (002) the floodplain was saturated at the survey date in 1995 but the plants grew on raised hummocks. Floods in the spring of 1996 washed away these hummocks and deposited several inches of gravel. At Beaver Creek (003), the plants grew on the slightly moist raised side of a swale, and the soil had a high percentage of reprecipitated calcium; the site lies within landtype 325 (Kuennen and Nielsen-Gerhardt 1985) with "soils formed in very limy alluvial deposits." Although the soil at Beaver Creek is highly calcareous, *Botrychium ascendens* is apparently not restricted to calcareous soils.
4. **CLIMATE FACTORS:** Moonworts in general are adapted to cool, moist climates. In Montana they are thus most common at low elevations in the northwest part of the state with its cool temperate, maritime influenced climate, while in semi-arid regions of the state (e.g. Granite, Deer Lodge, and Lewis and Clark counties) they are mostly found at higher elevations which receive heavy accumulations of snow. The occurrences of *Botrychium ascendens* on the KNF are found in the more dry eastern parts of the Forest, but these are located adjacent to wetlands. Mean annual normal precipitation (1951-1980) at the nearby stations at Fortine and Libby were 17.25 and 18.66 inches (National Oceanic and Atmospheric Administration 1982). Climatic fluctuations may dramatically effect the phenology, numbers, and distribution of moonwort sporophytes which produce above ground leaves in a growing season. Because it grows in subirrigated habitats, *B. ascendens* is likely to be less affected by precipitation during the growing season, and more affected by total annual precipitation.

#### F. POPULATION DEMOGRAPHY AND BIOLOGY

1. **PHENOLOGY:** In 1995, plants were found at Beaver Creek (003) in late June with immature sporangia and at West Fisher Creek (002) in early August with mature sporangia. An earlier survey of the West Fisher Creek site found only *Botrychium minganense* but it is not known whether *B. ascendens* has consistently later phenology. At Beaver Creek both *B. ascendens* and *B. crenulatum* were at approximately the same stage of development on the survey date. Mature plants were reported from northern Idaho in late July and August (Idaho Conservation Data Center, pers. commun.).
2. **POPULATION SIZE AND CONDITION:** In total numbers, among moonworts, *Botrychium ascendens* is exceeded in rarity in Montana only by *B. lineare* and *B. spathulatum* (neither known from the KNF), and on the KNF only by *B. paradoxum*. There were only six plants counted at each of the Beaver Creek and Houghton Creek

sites in 1995 and only five were relocated at Houghton Creek in 1996. The population at West Fisher Creek was probably extirpated by floods in 1996, although the persistence of underground gametophytes or dormant sporophytes cannot be ruled out. The populations in Idaho consist of just one or two plants. *B. ascendens* is reported as rare and scattered throughout its range (Wagner and Wagner 1986, P. Zika, pers. commun.), but it occurs in hundreds at its type locality in the Wallowa Mountains of Oregon (Wagner and Wagner 1986, Zika 1994) and in one Washington population (Washington Natural Heritage Program, pers. commun.). The individual plants of *B. ascendens* observed on the KNF have been robust and healthy.

3. **REPRODUCTIVE BIOLOGY:** See the discussion of life history following the introduction to this report.

#### G. POPULATION ECOLOGY

1. **COMPETITION:** On the KNF, *Botrychium ascendens* sites have relatively high ground cover by shrubs, forbs, and mosses. Competition in these habitats is expected to be much higher than in the forested habitats of other moonwort species. It is possible that root zone competition is reduced by periodic flooding.

The occurrence of moonworts, including *Botrychium ascendens*, in genus communities seems to run counter to the competitive exclusion principle, however, plant densities are usually so low that competition between moonwort species is not expected. Our observations also suggest that the individual species do have subtly different microhabitat preferences. For example, at Beaver Creek, where *B. ascendens* and *B. crenulatum* grew together, the six plants of *B. ascendens* were confined to a small area on the uphill edge of a swale on the north side of the opening in spruce woods, while *B. crenulatum* occurred in greater numbers and was distributed in the bottom of the swale throughout the opening. *B. ascendens* may be adapted to slightly dryer, warmer microsites; similar observations on microsite differences between these two species are reported from Oregon (Zika 1992).

2. **POSITIVE INTERACTIONS:** See the discussion of mycorrhizal relationships following the introduction to this report.
3. **HERBIVORY:** Herbivory of *Botrychium ascendens* was not observed, but nibbled sporophores of other species of moonworts was noted on the KNF in 1995 and 1996. The clusters of sporangia are often selectively browsed leaving the trophophore intact. Small animals, possibly rabbits, rodents, or snails, may play a role in spore dispersal of moonworts (Zika 1992).

- H. **LAND OWNERSHIP:** The Beaver Creek (003) population is on state land surrounded by the KNF on the Fortine District. The Houghton Creek (004) and West Fisher Creek (002) populations are on the Libby District of the KNF. The Houghton

Creek site was proposed for a land exchange with Plum Creek Timber Co. (U. S. Forest Service 1995), however 160 acres were removed from the exchange to provide protection for the *B. ascendens* occurrence (U.S. Forest Service 1996).

I. ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

1. THREATS TO CURRENTLY KNOWN POPULATIONS: Because of its low numbers and occurrence in dynamic riparian habitats, *Botrychium ascendens* is extremely vulnerable to extirpation from the KNF and Montana. Flooding in 1996 probably extirpated the West Fisher Creek population. The degree to which land use patterns in the drainage affected this flood event are not known. A new road was built by Plum Creek Timber Co. in 1995 nearby in the drainage and there is a long history of logging in the vicinity. The Beaver Creek population (003) is on state land but activities on KNF land upstream could potentially affect the hydrology of this site. The Houghton Creek site (004) was removed from a proposed land exchange with Plum Creek Timber Company (U. S. Forest Service 1996), however, land upstream from the site was exchanged, and the occurrence remains vulnerable to indirect effects of logging and road building on Plum Creek land.
2. MANAGEMENT PRACTICES AND RESPONSE: unknown
3. MANAGEMENT SUMMARY: Although the range of *Botrychium ascendens* is fairly broad, its distribution is highly disjunct and its population numbers are usually very low, thus Forest Service Region 1 sensitive status and Montana Natural Heritage Program S1 status remain appropriate.

Conservation management for this species should be a high priority for the sensitive plant program on the KNF. All known populations on the KNF and on adjacent state land deserve protection and proposals of management activities in their drainages must consider potential impacts to populations downstream. The KNF occurrences of *B. ascendens* are associated with streambottom riparian zones whose vulnerability to catastrophic flooding was demonstrated in 1995 at West Fisher Creek. The causes of this local flood event should be determined, and preventative measures should be explored to protect known *B. ascendens* sites from similar events. Permanent Ecodata plots established at Houghton Creek and at the flooded West Fisher Creek site in 1996 provide an opportunity to study vegetational succession and *B. ascendens* population persistence and potential reestablishment in these riparian habitats. Surveys to locate additional occurrences of *B. ascendens* on the KNF are needed. Project clearance surveys are often inadequate because they do not cover downstream riparian habitat which may be subject to indirect effects of management. *B. ascendens* is likely to be especially difficult to find due to its occurrence in habitats with heavy shrub and forb cover.

Wavy Moonwort  
*Botrychium crenulatum*

A. CLASSIFICATION

1. FAMILY: Ophioglossaceae, a family of primitive ferns
2. GENUS: *Botrychium* subgenus *Botrychium*
3. SPECIES: *Botrychium crenulatum* Wagner, described in Wagner and Wagner (1981).

B. PRESENT LEGAL OR OTHER FORMAL STATUS

1. FEDERAL STATUS

- a. U.S. FISH AND WILDLIFE SERVICE: Previously recognized as C2 (U.S. Fish and Wildlife Service 1993), indicating that it is a species "for which information now in the possession of the Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which sufficient data on biological vulnerability and threat are not currently available to support proposed rules." Recognition of C2 species was officially discontinued by the Service in 1996 (U.S. Fish and Wildlife Service 1996).
  - b. U.S. FOREST SERVICE: Sensitive in Region 1 (U.S. Forest Service 1994a).
  - c. BUREAU OF LAND MANAGEMENT: none.
2. STATE: The Montana Natural Heritage Program ranks the species G3? and S1 (Heidel 1996). The global rank G3 signifies vulnerability to extinction throughout its range; the state rank S2 signifies that it is imperiled because of rarity in Montana.

C. DESCRIPTION

1. GENERAL NONTECHNICAL DESCRIPTION: The sporophyte produces a single yellow-green leaf per year which is divided into two segments, a sterile trophophore and a fertile sporophore, which share a common stalk. The leaf stands up to 6 inches tall but is usually shorter. The trophophore is pinnatifid with usually three or four thin textured, non-overlapping pairs of pinnae and a terminal pinnae. The pinnae are broadly fan shaped with wavy margins. The sporophore is longer than the sterile segment when mature and bears "grape-like" sporangia which, when mature, release thousands of spores, which appear as yellow dust. Photographic slides of the sporophytes are provided in Appendix I. The small and rarely seen or studied gametophyte grows underground.

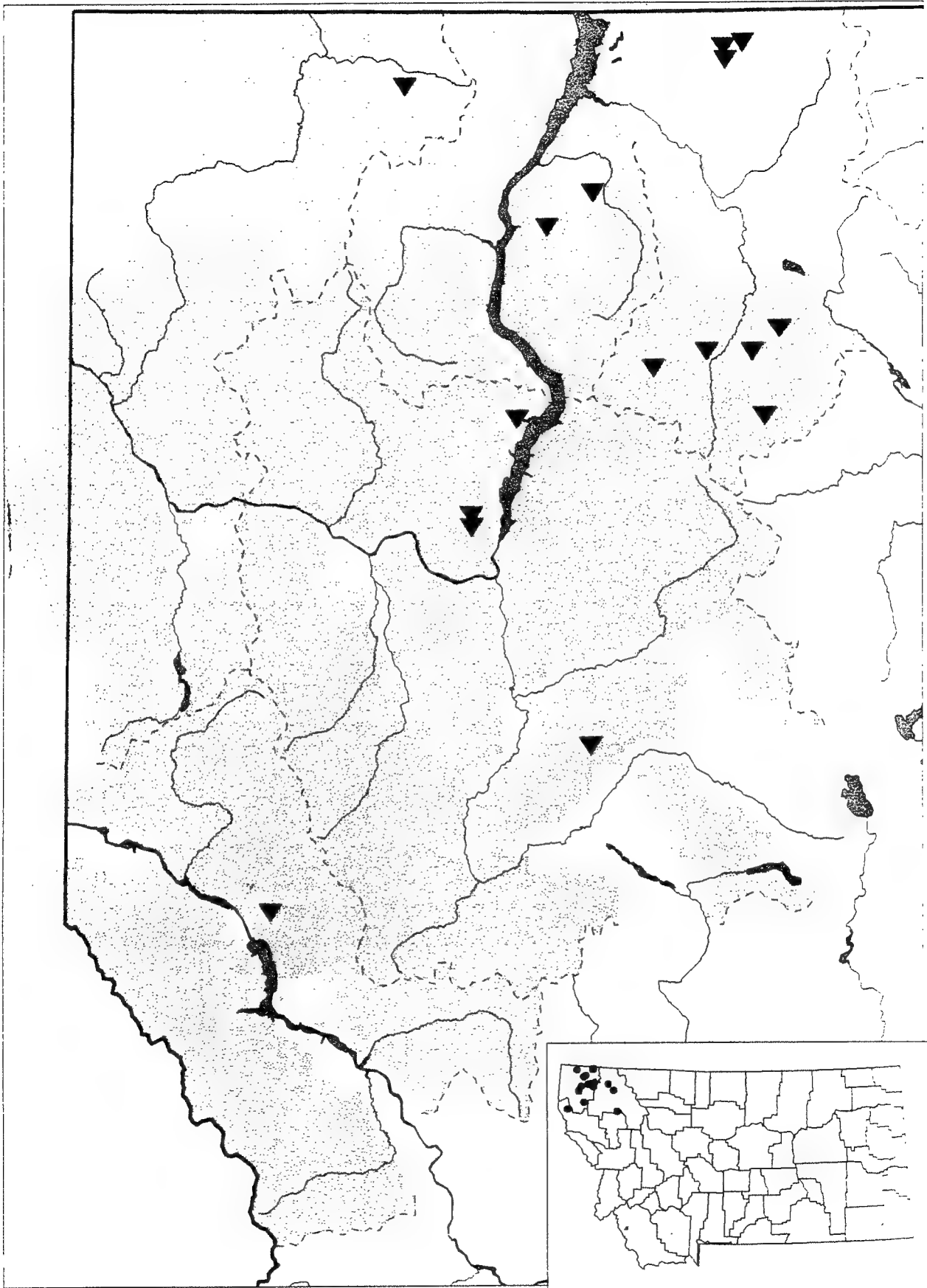
2. TECHNICAL DESCRIPTION: "Trophophore stalk 0.5-7 mm; blade yellow-green, oblong, 1-pinnate, to 6 X 2 cm, thin, herbaceous. Pinnae to 5 pairs, spreading, well separated, distance between 1st and 2d pinnae not or slightly more than between 2d and 3d pairs, basal pinna pair approximately equal in size and cutting to adjacent pair, broadly fan-shaped, undivided to tip, margins mainly crenulate to dentate, proximal pinnae with 1 or more shallow incisions, apex rounded, apical lobe linear to linear-cuneate, well separated from adjacent lobes, venation like ribs of a fan, midrib absent. Sporophores 1-2 pinnate, 1.3-3 times length of trophophore.  $2n = 90$ ." from Wagner and Wagner (1993)
3. LOCAL FIELD CHARACTERS: *Botrychium crenulatum* is one of the most difficult moonwort species to recognize and plants are often misidentified, especially juvenile and "old growth" plants (Zika 1994). On the KNF It is similar to and confused with *B. ascendens*, *B. lunaria*, and *B. minganense*. It is distinguished from *B. ascendens* by having broadly spreading pinnae with crenulate margins rather than strongly upswept pinnae with narrowly dentate to lacerate margins. It can be distinguished from *B. lunaria* by having non-overlapping pinnae which are thinner textured, more yellow-green, and more prominently veined. *B. minganense* is usually a deep dull green, somewhat succulent, and may have more pinnae pair than the usual 3-4 pair of *B. crenulatum*.

#### D. GEOGRAPHICAL DISTRIBUTION

1. RANGE: North America; Arizona, California, Idaho, Montana, Oregon, Nevada, Utah, and Wyoming (Wagner and Wagner 1993).
2. MONTANA DISTRIBUTION: *Botrychium crenulatum* is now reported from 19 sites in the northwestern part of the state in Flathead, Lake, and Lincoln Counties (Figure 2 inset).
3. OCCURRENCES ON THE KOOTENAI NATIONAL FOREST
  - a. CURRENT SITES: There are now 16 occurrences reported from the KNF, however, some sites are not represented by specimens, and there remain disagreements or uncertainty concerning the identities of some collections (see c. below). Most of the sites are in the eastern half of the Forest on the Fortine, Libby, and Rexford Districts, with single locations found on the Cabinet (reported on adjacent land owned by ASARCO) and Three Rivers Districts. Figure 2 shows the approximate locations of the 15 reported occurrences on the KNF. Element Occurrence Records and maps showing the precise locations are given in Appendix B.

Collections for which silhouettes were verified as *B. crenulatum* in 1995 (P. Zika, pers. commun.) come from Alexander Mountain (005), Basin Creek (004), Beaver Creek (007) and Chief Creek (009). Color photocopies of the specimens from Chief

**Figure 2. *Botrychium crenulatum* -- Wavy Moonwort**  
Occurrences on or near the Kootenai National Forest, Montana



Creek were also verified by W. H. Wagner (pers. commun.). In 1996, collections were taken from Lime Creek (017), Stewart Creek (019), Watertrough Draw (012), and Wolverine Creek (013), and these were determined to be *B. crenulatum* based on comparison with the previous years verified collections. Information on collections, including collectors, collection numbers, herbaria where they are deposited, and annotation comments are included on the individual Element Occurrence Records in Appendix B.

- b. HISTORICAL SITES: none
- c. UNVERIFIED/UNDOCUMENTED REPORTS: A previously reported occurrence at Can Creek is now believed to be based on misidentification and has been deleted from the Biological Conservation Database. Several KNF sites remaining in the database are represented by specimens with contested or uncertain identity and others are not represented by specimens. Peter Zika identified silhouettes of specimens from Alexander Creek (010) and Bristow Creek (011) as *B. manganense*, and a specimen from Sunday Creek (018) as "*B. lunaria* ?". In my opinion, the plants at Alexander Creek, which grew in heavy shade, are etiolated forms of *B. crenulatum*. Widely spreading pinnae with crenulate margins, indicative of *B. crenulatum*, were more apparent in life than on photocopies of pressed specimens (see photographic slide 2 in Appendix I). The two specimens from Bristow Creek, collected by J. Reny, are difficult for me to identify. The specimen from Sunday Creek is a large "monstrosity" and may not be typical of the population; its calcareous roadside habitat is typical for *B. crenulatum*. The small plants collected from Swamp Creek (008) could not be positively identified as *B. crenulatum* by Zika. No collections are available from Sutton Creek (003) or Rock Creek (002), and the habitat of these occurrences is atypical for the species. In 1996, surveys of Sutton Creek located large numbers of five species of moonworts, but *B. crenulatum* was not found. Surveys of the Rock Creek site located no moonworts in 1996 (J. Elliott, pers. commun.). Plants from high elevations in the Whitefish Range (Bluebird Lake .015, Green Mountain .016), have been tentatively identified as *B. crenulatum*, but may belong to an undescribed taxon; similar plants have been found at high elevations elsewhere in Montana (T. Spribille, pers. commun.). Resolution of these dubious reports will require additional collections and consultation with experts.
- d. AREAS SURVEYED BUT SPECIES NOT LOCATED: See Appendix A for a listing of areas which I searched for moonworts on the KNF in 1995 and 1996. Extensive additional surveys have been conducted by KNF personnel.
- E. HABITAT
  - 1. ASSOCIATED VEGETATION: Wagner and Wagner (1993) describe the habitat of *B. crenulatum* throughout its range as "marshy and springy areas." In Oregon, it grows in marshy meadows and in the wettest microsites of mesic meadows (Zika

1994). In contrast, the species is reported from *Thuja plicata* habitats in Idaho and Washington (Idaho Conservation Data Center and Washington Natural Heritage Program, pers. commun.)

On the KNF, the habitats of *Botrychium crenulatum* include wetlands dominated by native trees and shrubs and wet roadsides dominated by herbaceous exotic species. Ecodata plots of six occurrences with native vegetation are included in the *B. crenulatum* strata (Appendix C). Most of these sites are openings with wetland attributes, canopy dominance by deciduous trees or shrubs, and heavy ground cover by a high diversity of forbs and mosses. Climax vegetation (Hansen et al. 1995) includes *Picea/Cornus stolonifera* habitat types at Beaver Creek and Chief Creek, *Picea/Equisetum arvense* habitat type in the seral aspen stand at Swamp Creek, and *Thuja plicata* habitat types at Alexander Creek and Sutton Creek. The vegetation at Alexander Mountain was classified as an *Alnus sinuata* habitat type (Cooper et al. 1991, Hansen et al. 1995). The successional status of these openings is questionable. High water tables and occasional flooding may maintain these deciduous openings for relatively long periods. The Sutton Creek site is anomalous, with heavy canopy cover by *Thuja plicata*.

Tree cover in the plots is generally low to moderate (ca. 3-30%) except at Sutton Creek which has about 80% cover by *Thuja plicata*. *Picea* is constant and usually well represented (ca. 3-20% cover). Shrubs contribute moderate to high (ca. 20-90%) cover. Well represented shrubs and subshrubs in one or more plot include *Acer glabrum*, *Alnus incana*, *Alnus sinuata*, *Linnaea borealis*, *Rhamnus alnifolia*, *Rubus pubescens* and *Symphoricarpos albus*. Cover by grasses and sedges is low to moderate (1-20%) and mostly confined to areas outside the immediate moonwort habitat. The grass with highest constancy, *Elymus glaucus* was found in 50% of the plots. All plots have significant cover (ca. 20-80%) and diversity of forbs but few individual species are well represented. Forbs with relatively high constancy (>50%) include *Actaea rubra*, *Aralia nudicaulis*, *Clintonia uniflora*, *Galium triflorum*, *Mitella nuda*, *Pyrola asarifolia*, *Smilacina stellata*, and *Veronica americana*. Rattlesnake fern, *Botrychium virginianum*, was found in all plots. Moss cover is usually significant (ca. 3-80%). Mosses immediately associated with *Botrychium crenulatum* include species of *Brachythecium*, *Bryum*, *Drepanocladus*, *Hypnum*, and *Plagiomnium* (Appendix G).

Analysis of Ecodata using Strata (Appendix C) shows that the vegetation of *Botrychium crenulatum* sites on the KNF shares many attributes with that of *B. ascendens* sites (Appendix C). These two strata have relatively high indices of diversity, reflecting high shrub, forb, fern, and moss cover by a large number of species. In contrast, other sensitive moonworts on the KNF usually grow in habitats with high canopy cover by conifers (mostly *Thuja plicata*) and depauperate middle and lower vegetation layers. The vegetation at Sutton Creek is more similar to that of the forest dwelling moonwort species, and its inclusion in the *B. crenulatum* strata lessens these similarities and differences in the analysis.



Many of the known populations of *B. crenulatum* on the KNF (Basin Creek .004, Lime Creek .017, Stewart Creek .019, Sunday Creek .018, Water Trough Draw .012, Wolverine Creek .013) are in old roadways or along active roads. These sites are dominated by exotic forbs and graminoids, but native wet site species are also present. Spruce seedlings are present at some of the roadside sites.

Plants tentatively identified as *B. crenulatum* from high elevations in the Whitefish Range grow in habitat quite different from the lowland occurrences on the KNF. These sites are rocky, open habitats dominated by native alpine forbs. These plants may belong to a different, undescribed taxon (T. Spribille, pers. commun.).

Throughout its range *B. crenulatum* is known to grow with the other moonworts *B. ascendens*, *B. lunaria*, *B. minganense*, and *B. simplex* (Wagner and Wagner 1993). At most sites on the KNF it grows alone, but it occurs with *B. ascendens* at Beaver Creek (007), with *B. minganense* at Swamp Creek (008), and nearby *B. lunaria* at Basin Creek (004).

Additional information on associated vegetation is provided in the general site description fields of the Element Occurrence Records in Appendix B and in the Ecodata tables in Appendix C.

2. **TOPOGRAPHY:** All but two populations were found at relatively low elevations ranging from 2,400 to 4,500 feet. These are in glaciated valley stream bottoms or along roads in glaciated valleys, where the altered hydrology may approximate natural wetland features. There is usually little or no slope to the sites, and their drainages have various aspects. At more mesic sites (e.g. Alexander Mountain .005), plants are scattered across flats, while at the wettest sites (e.g. Chief Creek .009) plants grow on mossy hummocks which rise above the water table. Two occurrences (Bluebird Lake .015, Green Mountain .016) are located at high elevations in the Whitefish Range at 6,840 and 7,700 feet, below rock ledges.
3. **SOIL RELATIONSHIPS:** More than those of other species of *Botrychium* on the KNF, the distribution of *B. crenulatum* seems to be related to soil conditions. While most of the other species usually grow in deep layers of litter and humus which are relatively well drained, the substrates of *B. crenulatum* usually have a significant mineral fraction, are usually calcareous, and are often poorly drained. At some roadside sites the substrate was described as compacted gravel. Most of the sites are within landtypes 322, 323, or 325 (Kuennen and Nielsen-Gerhardt 1995) with soils derived from calcareous alluvial deposits and glacial till. The lime is derived from the Precambrian Siyeh formation, which is mapped on the Kalispell 1" × 2" quadrangle (Harrison et al. 1992) as the Helena formation, composed of dolomites and dolomitic siltites.

4. CLIMATE FACTORS: Moonworts in general are adapted to cool, moist climates. In Montana they are thus most common at low elevations in the northwest part of the state with its cool temperate, maritime influenced climate, while in semi-arid regions of the state (e.g. Granite, Deer Lodge, and Lewis and Clark counties) they are mostly confined to higher elevations which receive heavy accumulations of snow. The concentration of *Botrychium crenulatum* occurrences are in the eastern part of the KNF, which has lower precipitation than the western part. The dryer climate may be a factor in the formation of calcareous soil types (see above) which are more prevalent in the eastern part of the Forest (L. Kuennen, pers. commun.). Climatic fluctuations may dramatically effect the phenology, numbers, and distribution of moonwort sporophytes which produce above ground leaves in a growing season. Because it grows in subirrigated habitats, *B. crenulatum* is likely to be less affected by precipitation during the growing season, and more affected by total annual precipitation.

#### F. POPULATION DEMOGRAPHY AND BIOLOGY

1. PHENOLOGY: Wagner and Wagner (1993) state that the leaves appear in middle to late spring and die in late summer and in dry years may be of shorter duration or not appear at all. Plants with immature sporophores were seen on the KNF as early as late June and senescent plants were found in late August. At high elevations in the Whitefish Range plants were found in late September. Compared to other species of moonworts on the KNF, *B. crenulatum* generally has earlier phenology, but this may be effected by seasonal climate and watertable status. Populations on sunny roadsides are the first to mature.
2. POPULATION SIZE AND CONDITION: Most population numbers reported from Montana are small (< 50 fronds), but a relatively large population with 100-200 fronds was found in Flathead County by T. Spribille. Numbers in Idaho are also small (Idaho Conservation Data Center, pers. commun.). In 1994 thousands of fronds were observed in a meadow in the Uinta Mountains of Utah (Utah Natural Heritage Program, pers. commun.) and some large populations are also reported from Washington (Washington Natural Heritage Program, pers. commun.). Many populations on the KNF are small but populations at Alexander Mountain (005), Alexander Creek (010), and Beaver Creek (007) were estimated to consist of about 100 fronds each in 1995. The Alexander Creek site had fewer fronds on the survey date in 1996, possibly because of dormancy or delayed phenology caused by a high water table at the site. Roadside sites at Basin Creek (004), Lime Creek (017), Stewart Creek (019), and Water Trough Draw (012) support over 40 plants apiece, demonstrating some success of the species in these habitats. All populations on the KNF cover less than 1 acre each. Population parameters for individual sites are reported in the size and element occurrence data fields of the Element Occurrence Records in Appendix B.

3. REPRODUCTIVE BIOLOGY: See the discussion of life history following the introduction to this report.

#### G. POPULATION ECOLOGY

1. COMPETITION: On the KNF, many *Botrychium crenulatum* sites have relatively high ground cover by shrubs, forbs, and mosses. Competition in these habitats is expected to be much higher than in the forested habitats of other moonwort species. It is possible that root zone competition is reduced by periodic flooding. At Alexander Creek (010) *B. crenulatum* grows under a dense shrub canopy (90%) and the moonworts are etiolated and probably have reduced reproductive capacity. Plants growing in sunny roadside habitats are often robust and have early, copious spore production.

The occurrence of moonworts, including *Botrychium crenulatum*, in genus communities seems to run counter to the competitive exclusion principle, however, plant densities are usually so low that competition between moonwort species is not expected. Our observations also suggest that the individual species do have subtly different microhabitat preferences. For example, at Beaver Creek (007), where *B. crenulatum* and *B. ascendens* grew together, the six plants of *B. ascendens* were confined to a small area on the uphill edge of a swale, on the north side of the opening in spruce woods, while *B. crenulatum* occurred in greater numbers and was distributed in the bottom of the swale throughout the opening. Thus *B. crenulatum* may be adapted to slightly wetter, colder microsites; similar observations on microsite differences between these two species are reported from Oregon (Zika 1992). At many of its occurrences on the KNF *B. crenulatum* is the only moonwort, perhaps because of unique soil adaptations (see above).

2. POSITIVE INTERACTIONS: See the discussion of mycorrhizal relationships following the introduction to this report.
  3. HERBIVORY: Herbivory of *Botrychium crenulatum* was not observed, but nibbled sporophores of other species of moonworts was noted on the KNF in 1995 and 1996. The clusters of sporangia are often selectively browsed leaving the trophophore intact. Small animals, possibly rabbits, rodents, or snails, may play a role in spore dispersal of moonworts (Zika 1992).
- H. LAND OWNERSHIP: All but two populations in the vicinity are on KNF land, on the Eureka, Fortine, Libby and Three Rivers Districts. The Beaver Creek (007) population is on state land surrounded by the Fortine District and the Rock Creek (002) population is on ASARCO land adjacent to the Cabinet District.

#### I. ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

1. **THREATS TO CURRENTLY KNOWN POPULATIONS:** The roadside populations at Basin Creek (004), Stewart Creek (019), and Sunday Creek (018) are potentially threatened by traffic, road maintenance, herbicide spraying, and trampling by cattle. At Basin Creek, the population was directly impacted in 1996 by skidding and decking of logs (L. Ferguson, M Arvidson, pers. commun.); the location of the population was known prior to administration of the sale. The populations in the old roadways at Lime Creek (017), Water Trough Draw (012), and Wolverine Creek (013) would be threatened if the roads were reopened.

The intact native wetland habitats of *B. crenulatum* at other sites on the KNF are potentially impacted by road construction, logging, or other activities in their drainages, especially upstream, which may effect the sites' hydrology and/or access to the site by cattle, game, and humans. Road stream and draw crossings and log decks are often located along low gradient reaches where *B. crenulatum* and other sensitive plants (e.g. ladies slipper orchids) are most likely to be found. In 1996, road widening, log decking, and extensive soil disturbance occurred just above the Alexander Mountain (005) population, leaving the occurrence vulnerable to washouts and siltation. At Chief Creek (009) many plants were trampled in 1995, apparently by game, but possibly by people; this site had a conspicuously flagged trail leading to it. Weed invasions are another potential threat to the native habitats. Canada thistle (*Cirsium arvense*) was present in the sampled Ecodata plots at Alexander Mountain (005) and Beaver Creek (008), and the rhizomatous Kentucky bluegrass (*Poa pratensis*) was well represented in one plot at Swamp Creek (008).

2. **MANAGEMENT PRACTICES AND RESPONSE:** The occurrence of *Botrychium crenulatum* at roadside sites is an indication that the species is adapted to colonizing bare soil of disturbed sites. It is common on the KNF to observe many native wetland plants in roadside ditches, and among moonworts on the KNF, *Botrychium crenulatum* grows in the wettest habitats. *B. crenulatum* may also be resistant to cattle grazing, as evidenced by cattle grazing of roadsides where it grows on the Fortine District.

At Alexander Mountain (005), the population is just below where a gravel road crosses the drainage and this population survives as perhaps the largest and healthiest on the KNF; it may be significant that a seep with standing water is located below the road and above the population, thus road construction may not have significantly altered the hydrology at this site. In 1996, this road was widened, a log deck was placed just above the population, and soil was disturbed on the roadway and in the cutting unit above; future effects on the population await to be determined. Recovery of the Basin Creek population following log skidding and decking on the site in 1996 also awaits determination.

3. **MANAGEMENT SUMMARY:** Management activities (i.e. log decking, skidding, and road widening without culvert maintenance) which may impact populations of

*Botrychium crenulatum* occurred at two sites in 1996. Although effects have yet to be determined, these activities demonstrate a lack of communication or procedural inadequacies of timber sale administration. Proposals of management activities must not only assess potential impacts, but must outline steps to minimize these impacts. These steps should be outlined in writing on timber sale documents, and all persons concerned should be knowledgeable of population locations and steps to avoid impact.

Questions concerning the identities of reported *Botrychium crenulatum* occurrences remain and make assessment of vulnerability of the species difficult. Identification of plants in the field has been done by several workers, often specimens have not been collected or photographs taken, and even when collections were taken, they are sometimes in poor condition or in insufficient numbers for positive determination (P. Zika, pers. commun.). There are trends in geographical and ecological distribution of the species, but exceptions (e.g. highly disjunct occurrences and those in cedar and high elevation habitats) are incompletely studied, and the species, more than others, remains taxonomically difficult.

The priority for conservation management of this species on the KNF should be protection of native wetlands with significant known, verified populations (e.g. Alexander Mt. .005, Chief Creek .009) and further study of the species at questionable sites. Since *Botrychium crenulatum* is often not associated with genus communities a separate conservation strategy may be required for this species.

Mingan Island Moonwort  
*Botrychium minganense*

A. CLASSIFICATION

1. FAMILY: Ophioglossaceae, a family of primitive ferns
2. GENUS: *Botrychium* subgenus *Botrychium*
3. SPECIES: *Botrychium minganense* Victorin. This a controversial species which has often been considered a variety of *B. lunaria*. The morphological and cytological distinctions between these two taxa are discussed in Wagner and Lord (1956). Throughout this report, the modern taxonomy of *Botrychium*, as represented in Wagner and Wagner (1993), is followed and *B. minganense* is recognized as a distinct species, however, it should be realized that disagreement continues. Many floras (e.g. Dorn 1992, Hitchcock and Cronquist 1976) designate plants referable to *B. minganense* as *B. lunaria* var. *onondagense* and many herbarium sheets of *B. minganense* are variously identified as *B. onondagense*, *B. lunaria* var. *onondagense*, *B. lunaria* var. *minganense*, or just *B. lunaria*. Taxonomic questions remain concerning this species, and what is now considered *B. minganense* in the west may include more than one cryptic taxa (Hauk 1995, W. Wagner, pers. commun.).

B. PRESENT LEGAL OR OTHER FORMAL STATUS

1. FEDERAL STATUS

- a. U.S. FISH AND WILDLIFE SERVICE: none
- b. U.S. FOREST SERVICE: Sensitive in Region 1 (U.S. Forest Service 1994a).
- c. BUREAU OF LAND MANAGEMENT: none

2. STATE: The Montana Natural Heritage Program ranks the species G4 and S2S3 (Heidel 1996), signifying that it is apparently secure globally but imperiled or vulnerable because of rarity in Montana. It is recommended that state rank be changed to S3 to reflect the many populations discovered on the KNF in 1996. This is the point where most taxa are dropped from tracking by MTNHP, however, there are compelling reasons not to do this at this point. See the discussion under management summary in this status review and the status recommendations at the end of this report.

C. DESCRIPTION

1. GENERAL NONTECHNICAL DESCRIPTION: Each year the sporophyte produces a single dull green, somewhat fleshy frond which is divided into two parts, a sterile trophophore and a fertile sporophore, which share the same stalk. The frond is usually less than 6 inches tall and is often much smaller. The trophophore is pinnatifid with as many as ten pair of non-overlapping pinnae. The pinnae are variable but they are usually narrowly fan shaped and have nearly entire margins. The fertile leaf segment is longer than the sterile segment when mature and bears grape-like sporangia which, when mature, release thousands of spores which appear as yellow dust. Photographic slides showing sporophytes from several sites are included in Appendix I. The small gametophyte grows underground and is rarely seen or studied.
  
2. TECHNICAL DESCRIPTION: "Trophophore stalk 0-2 cm, 0 to 1/5 length of trophophore rachis; blade dull green, oblong to linear, 1-pinnate, to 10 X 2.5 cm, firm to herbaceous. Pinnae to 10 pairs, horizontal to slightly spreading, approximate to remote, distance between 1st and 2d pinnae not or slightly more than between 2d and 3d pairs, basal pinna pair approximately equal in size and cutting to adjacent pair, occasionally basal pinnae and/or some distal pinnae elongate, lobed to tip, nearly circular, fan-shaped or ovate, sides somewhat concave, margins nearly entire, shallowly crenate, occasionally pinnately lobed or divided, apex rounded, venation like ribs of a fan with short midrib. Sporophores 1-pinnate, 2-pinnate in very large, robust plants, 1.5-2.5 times length of trophophore.  $2n = 180$ ." from Wagner and Wagner (1993).
  
3. LOCAL FIELD CHARACTERS: *Botrychium minganense* is a variable species and is similar in appearance to *B. ascendens*, *B. crenulatum*, and *B. lunaria*. It can be distinguished from *B. ascendens* by its dull green color and usually spreading or slightly ascending rather than strongly ascending pinnae which usually have entire or broadly lobed rather than lacerate margins. However, KNF plants identified as *B. minganense* by W. H. Wagner (pers. commun.) have ascending pinnae and lacerate pinnae margins similar to *B. ascendens*, but color, texture, and habitat are typical of *B. minganense*. Similar plants have also been found on the Colville National Forest in Washington. *Botrychium minganense* differs from *B. crenulatum* by having dull green rather than yellow-green color, a more fleshy texture, and by often having more than 3 or 4 pairs of pinnae which are usually narrower and have entire rather than crenulate margins. It differs from *B. lunaria* by having narrower pinnae which do not overlap.

#### D. GEOGRAPHICAL DISTRIBUTION

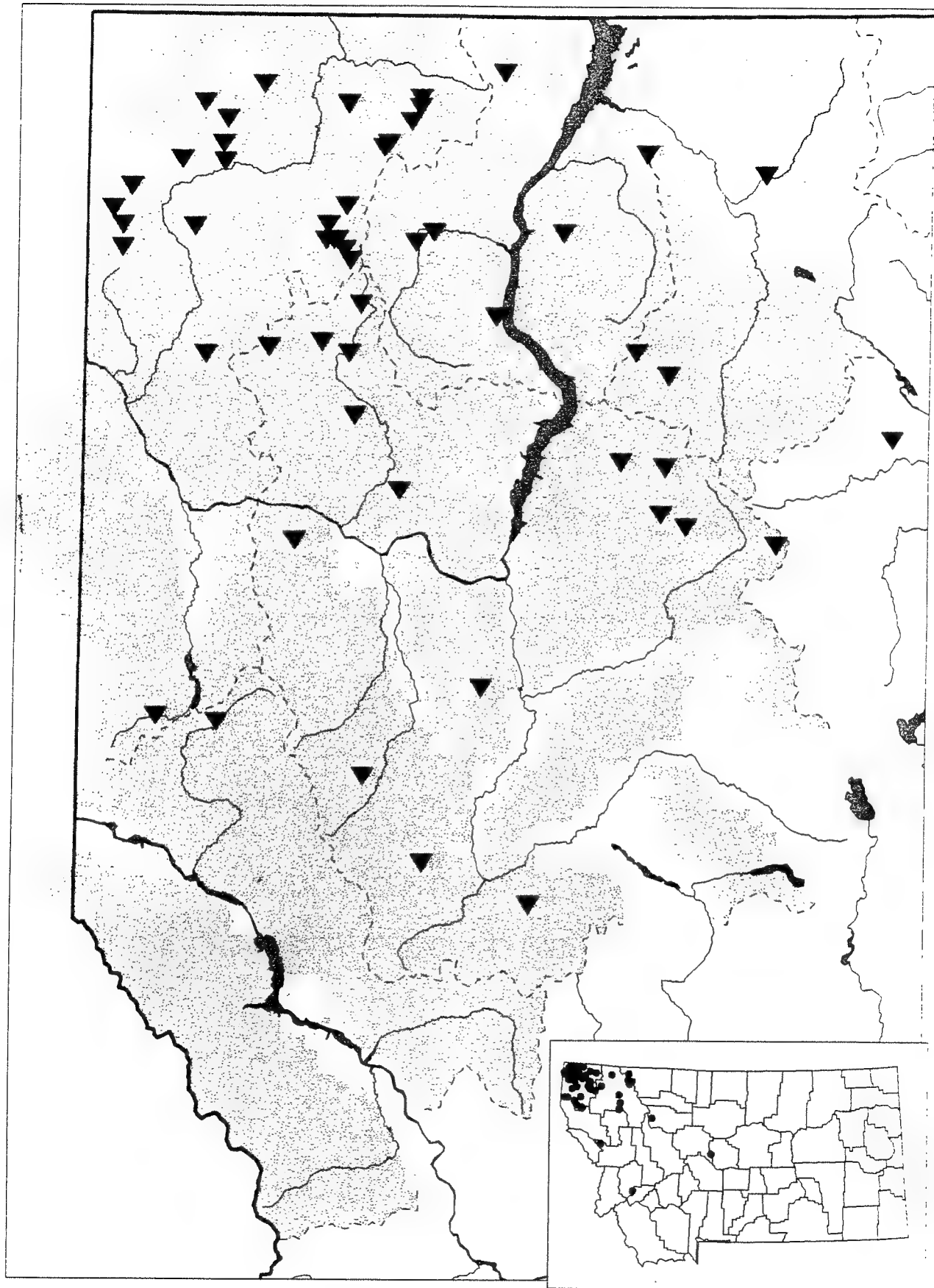
1. RANGE: Transcontinental across northern North America, extending south in the western mountains; St. Pierre, Miquelon; Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Northwest Territories, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan, Yukon; Alaska, Arizona, California,

Colorado, Idaho, Maine, Michigan, Montana, Nevada, New Hampshire, New York, North Dakota, Oregon, Utah, Vermont, Wisconsin, Wyoming (Wagner and Wagner 1993).

2. **MONTANA DISTRIBUTION:** In 1992 there were just seven known occurrences of *Botrychium minganense* in Montana (Achuff 1992) and by 1995, prior to commencement of this project there were 23 occurrences in the Biological Conservation Database. Adding 1995 and 1996 documentations and discoveries on the KNF and elsewhere there are now at least 62 occurrences known in Montana. These are from the northwestern part of the state in Cascade, Flathead, Glacier, Granite, Lake, Lincoln, Missoula, and Teton counties (Figure 3 inset).
3. **OCCURRENCES ON THE KOOTENAI NATIONAL FOREST**
  - a. **CURRENT SITES:** There are now 53 populations of *Botrychium minganense* reported on the KNF with occurrences on all districts (Table 1). Sixteen of these are represented by specimens, silhouettes of which were verified by P. Zika (pers. commun.). Color photocopies of specimens from South Fork Big Creek and Sutton Creek were also verified by W. H. Wagner (pers. commun.). Most occurrences are in the northwestern part of the Forest. The approximate locations are shown in Figure 3. Element Occurrence Records and topographic maps showing the precise locations are given in Appendix B.
  - b. **HISTORICAL SITES:** One occurrence (North Fork Dodge Creek .041) on the Eureka District is represented only by a 1971 collection (labeled *B. lunaria* var. *onadogense*) deposited at the herbarium of the University of Montana (MONTU); I searched for but did not relocate this population in 1995.
  - c. **UNVERIFIED/UNDOCUMENTED REPORTS:** Peter Zika identified silhouettes of specimens, which we identified as *B. crenulatum*, from Alexander Creek and Bristow Creek as *B. minganense*. In my opinion, the plants at Alexander Creek, which grow in heavy shade, are etiolated forms of *B. crenulatum*. Widely spreading pinnae with crenulate margins, indicative of *B. crenulatum*, were more apparent in life than on photocopies of pressed specimens (see slide 2 in Appendix I). The two specimens from Bristow Creek, collected by J. Reny, are difficult for me to identify and I could not relocate the population in 1996. Element Occurrence Records in Appendix B treat these two occurrences as *B. crenulatum*. In 1996 W. H. Wagner (pers. commun.) identified plants from Othorp-Morgan Lake (066) with atypical morphology and habitat as *B. minganense* or possibly an undescribed species "*B. sublunaria*." Tom Desy (Three Rivers District) reported *B. minganense* from Door Skeels recreation area but I was unable to locate any plants in 1995 or 1996. Reports of unidentified moonworts from North Fork Parsnip Creek (B. Koncerak, pers. commun.) and Seventeenmile Creek (L. Ferguson, pers. commun.) may also be this species; these have not been entered in the BCD.



**Figure 3. *Botrychium minganense* -- Mingan Island Moonwort**  
Occurrences on or near the Kootenai National Forest, Montana



- d. AREAS SURVEYED BUT SPECIES NOT LOCATED: See Appendix A for a listing of areas which I searched for moonworts on the KNF.

E. HABITAT

1. ASSOCIATED VEGETATION: Throughout its range *Botrychium minganense* grows in a broad variety of moist habitats. In Michigan it usually grows in second growth deciduous forests (Wagner and Lord 1956). In Idaho it is reported from western red cedar, hemlock, grand fir, and lodgepole pine forest habitat types as well as from alder thickets (Lorain 1990, Idaho Conservation Data Center, pers. commun.). In Washington it is found mostly in riparian areas with western red cedar or mixed conifers but is also reported from rocky subalpine and alpine habitats (Washington Natural Heritage Program, pers. commun.). In Montana it is known from rocky alpine areas, montane grasslands, mossy lakeshores, alder thickets, and conifer and deciduous forests. Vegetation where *B. minganense* grows in the Ninemile Valley on the Lolo National Forest is *Thuja plicata*/*Oplopanax horridum* and *Thuja plicata*/*Clintonia uniflora* habitat types (Achuff 1992), also the predominant habitats on the KNF.

*Botrychium minganense* has the broadest ecological amplitude of the sensitive moonworts on the KNF, but most occurrences, including all large populations, are in mature stands of western red cedar and/or western hemlock. The most common habitats are *Thuja plicata*/*Oplopanax horridum*, *Thuja plicata*/*Clintonia uniflora*, and *Tsuga heterophylla*/*Clintonia uniflora* types. A few small populations of *Botrychium minganense* are also found on the KNF in *Abies lasiocarpa*/*Clintonia uniflora* habitat types (Weigel Creek .054, Upper Weigel Creek .061, Wiegel Mountain .055), an *Abies grandis*/*Clintonia uniflora* habitat type (Brush Creek .042), a seral aspen stand with *Picea/Equisetum arvense* potential (Swamp Creek .045), a *Picea/Cornus stolonifera* habitat type (Grave Creek Campground .047), and a heavily grazed *Agoseris stolonifera* disclimax next to an alkaline pothole (Othorp-Morgan Lake .066).

Ecodata from 18 plots are included in the *B. minganense* strata (Appendix C). Included are 15 plots with cedar or hemlock habitat types, and single examples of spruce, alder, and grazed meadow habitats. The strata has low indices of similarity, even though it does not represent the full range of habitats on the KNF.

In the *Thuja plicata* and *Tsuga heterophylla* habitat types canopy cover is usually high and is mostly contributed by medium to very large trees of these species. *Picea* has high constancy but is never abundant. The largest cedar at some sites (e.g. Red Top Creek .038, South Meadow Creek .014) are probably over 1,000 years old. At four sites (Beetle Creek .033, Hemlock Creek .037, Spread Creek .015, and Zulu Creek Pack Trail .031) in drainages which were mostly burned by fires early in this century, *Botrychium minganense* appears to be confined to old growth remnants missed by the

fires, but at another site (Cedar Creek .027) the plants grow next to an old fire scarred, sawed stump in maturing second growth cedar. It is possible that fire intensity and its effects on the duff layer and fungal communities are important factors which determine appropriate habitat for the species. One plot sampled at Bull River (047) is dominated by seral pole sized *Abies grandis*. Although clearcuts and stands of young trees adjacent to *B. minganense* populations were searched, no moonworts were found in these habitats (Appendix A).

In the cedar and hemlock habitats, understory cover by shrubs, graminoids, forbs, ferns, and mosses is usually low to moderate. Exceptions are sites in very old stands of cedar which have more open tree canopies and heavy cover by *Oplopanax horridum* and/or *Athyrium filix-femina*. Understory vascular plant species with high constancy (>50%) in Ecodata plots include the subshrub *Linnaea borealis*, the forbs *Actaea rubra*, *Clintonia uniflora*, *Galium triflorum*, *Orthilla secunda*, *Smilacina stellata*, *Streptopus amplexifolius*, *Tiarella trifoliata*, and *Trillium ovatum*, and the ferns *Athyrium filix-femina*, *Botrychium virginianum*, and *Gymnocarpium dryopteris*. Mosses collected in close association with *Botrychium minganense* include species of *Aulacomnium*, *Brachythecium*, *Dicranum*, *Eurhynchium*, *Mnium*, *Plagiomnium*, *Ptilium*, *Rhizomnium*, *Rhytidiopsis*, *Roellia*, and *Timmia* (Appendix G).

Throughout its range *Botrychium minganense* was reported growing with *B. echo*, *B. hesperium*, *B. lanceolatum*, *B. lunaria*, *B. matricariifolium*, *B. montanum*, *B. mormo*, *B. paradoxum*, and *B. pinnatum* (Wagner and Wagner 1983). On the KNF it grows with *B. ascendens*, *B. crenulatum*, *B. lanceolatum*, *B. montanum*, *B. paradoxum*, *B. pedunculatum* and *B. pinnatum*. *Botrychium minganense* and *B. montanum* are an especially common pair on the KNF, although they usually occupy slightly different microhabitats (see discussion of soil relationships below, and results from monitoring transects at French Creek in the Results section).

Additional information on associated vegetation is provided in the general site description fields of the Element Occurrence Records in Appendix B and in the Ecodata tables in Appendix C.

2. TOPOGRAPHY: On the KNF, *Botrychium minganense* grows at elevations ranging from 2,850 to 5,000 feet. The sites are usually in glaciated stream bottoms or are topographic microfeatures of glaciated slopes such as level benches, swales, and gentle slopes or draws with seeps or streamlets. The microsites are usually level and are in drainages with all aspects. Microtopography of many sites is undulating or patterned, caused by windthrow hummocks and buried rotten logs.
3. SOIL RELATIONSHIPS: At most sites the plants grow in thick layers of litter or humus rather than in soil, but at a few floodplain sites they grow in silty alluvium with a high organic fraction. The duff layers are expected to be acidic because they are derived from conifer, mostly cedar, leaves (L. Kuennen, pers. commun.),

however, ground water at some sites may be calcareous. Two sites, Zulu Creek (028) and Can Creek (044), which support moonwort genus communities with *B. minganense* in significant numbers, lie in drainages surrounded by the Helena formation composed of dolomites and dolomitic siltites (Harrison et al. 1992), which is associated with calcareous soils in the eastern part of the KNF; limy seeps and rivulets were observed at Can Creek. All but a few sites are within landtypes 352, 355, and 357 (Kuennen and Gerhardt 1984) with "soils formed in volcanic ash-influenced loess overlying dense glacial till."

*Botrychium minganense* often grows nearby *B. montanum*, but the two species seem to have slightly different microhabitat preferences, probably related to substrate moisture. At French Creek *B. montanum* grows mostly on the uphill side of a small seep while *B. minganense* is concentrated on the downhill side.

4. CLIMATE FACTORS: The majority of *Botrychium minganense* occurrences on the KNF are in the wetter western part of the Forest and most large populations are at relatively high elevations which receive heavy snow accumulation. Moonworts in general are adapted to cool, moist climates. In Montana they are thus most common at low elevations in the northwest part of the state with its cool temperate, maritime influenced climate, while in semi-arid regions of the state (e.g. Granite and Deer Lodge Counties) they are confined to higher elevations which receive heavy accumulations of snow. Climatic fluctuations may dramatically effect the phenology and numbers of moonwort sporophytes which produce above ground leaves in a growing season; in dry years fewer plants are expected to be found and the length of the growing season is expected to be shorter.

#### F. POPULATION DEMOGRAPHY AND BIOLOGY

1. PHENOLOGY: Wagner and Wagner (1993) state that leaves appear in spring through summer. On the KNF, plants were observed with immature sporangia from mid-July to late August, and plants with spores being released were observed as early as late July and as late as October. Data from monitoring transects at French Creek (021) show that *Botrychium minganense* has a staggered phenology of frond emergence (see results section). Individual plants of *Botrychium minganense* and *B. montanum* were mapped and measured in permanent belt transects in mid-July and again in early-September of 1995 and 1996. At the latter date in both years some fronds of both species had disappeared, some were nibbled, others had grown larger, and new fronds had emerged. *Botrychium minganense* has an earlier phenology than its often close associate *B. montanum*.
2. POPULATION SIZE AND CONDITION: Reported population numbers in Montana are usually small, most populations consisting of fewer than 50 plants and many with less than 10. Likewise, most of the 27 reported populations in Idaho consist of only a few plants, but a few have as many as 500 (Idaho Conservation Data Center, pers.

commun.). Many large populations are reported from Washington (Washington Natural Heritage Program, pers. commun.).

On the KNF, the bulk of the populations consist of fewer than 50 plants but more significant numbers (50-200) were found in 1995 at Can Creek (044), French Creek (021), Kelsey Creek (025), Red Top Creek (038), and Zulu Creek (028). These large populations all occur in mature stands of western red cedar at relatively high elevations. Censuses in 1996 at most of these sites found fewer emergent fronds, but numbers at Kelsey Creek were about the same, possibly because the site is subirrigated. 1996 had lower summer precipitation but spring flooding resulted in persistent high water tables at wetland sites such as Kelsey Creek. A large, dense population was found in 1996 at the relatively low elevation floodplain of Sutton Creek (049), where other moonworts were previously reported. The largest populations cover 5 to 10 acres, while most others cover less than one acre. Population parameters for individual sites are reported in the size and element occurrence data fields of the Element Occurrence Records in Appendix B.

3. **REPRODUCTIVE BIOLOGY:** See the discussion of life history following the introduction to this report. *Botrychium minganense* is capable of vegetative reproduction by underground sporophytic propagules, called gemmae (Farrar and Johnson-Groh 1990), possibly explaining high densities and clumps of this species which are sometimes seen on the KNF.

#### G. POPULATION ECOLOGY

1. **COMPETITION:** In the western red cedar habitats where *Botrychium minganense* is most common on the KNF, competition for light is high, but rootzone competition is low. Increased competition may be a factor in the apparent exclusion of *Botrychium minganense* from a clearcut at Red Top Creek (038). At this site, *B. minganense* grows in intact *Tsuga heterophylla* habitat surrounding a clearcut in the same habitat type and having similar topographic features. The clearcut was thoroughly searched for moonworts by two people for a total of over 5 hours, concentrating on swales with seeps, but none were found. When the clearcut was left, *B. minganense* was found within minutes. Ecodata plots were sampled in the moonwort habitat and in a swale within the clearcut without moonworts (Appendix C). The most obvious differences between these paired plots are 1) decreased canopy cover by trees in the clearcut 2) increased ground cover by wood and a corresponding decrease in litter cover in the clearcut, and 3) increased cover by shrubs, forbs, graminoids, ferns, and mosses in the clearcut.

The occurrence of moonworts, including *Botrychium minganense*, in genus communities seems to run counter to the competitive exclusion principle, however, plant densities are usually so low that competition between moonwort species is not expected. Our observations also suggest that the individual species have subtly

different microhabitat preferences (see discussion of soil relationships above). At Zulu Creek, however, several plants of *B. minganense* grew within inches of a single plant of *B. paradoxum* in apparently equivalent habitat, suggesting that *B. minganense* may have a competitive advantage over *B. paradoxum* in this habitat. The opposite may be true at Cub Ridge in the Anaconda Range, where *B. paradoxum* is the dominant moonwort and only a few plants of *B. minganense* were found (Vanderhorst 1993).

2. **POSITIVE INTERACTIONS:** All *Botrychium* species are believed to be obligately dependent on mycorrhizal relationships in both the gametophyte and sporophyte generations. See the discussion of mycorrhizal relations following the Introduction of this report. Although assumptions of randomness were not met, statistically significant positive close associations were found in microplots at Zulu Creek between *B. minganense* and *Osmorhiza chilensis*, *Tiarella trifoliata*, and *Viola glabella* (L. Crone, pers. commun.). These associations may be an indication of shared habitat preferences (e.g. wet microsites) or could be a manifestation of mycorrhizal links between the moonworts and these forbs.
- c. **HERBIVORY:** Herbivory of *Botrychium minganense* was observed and documented at French Creek (021) in 1995 and 1996 (see Results section), and has been reported elsewhere for moonworts in general (Zika 1992). The clusters of sporangia are often selectively browsed leaving the trophophore intact. Small animals, possibly rabbits, rodents, or snails, may play a role in spore dispersal of moonwort species (Zika 1992).
- H. **LAND OWNERSHIP:** All but one population documented in this report are on KNF land. Populations are known from all Districts. The occurrence at East Pipe Creek (036) is on Plum Creek Timber land. The Houghton Creek site (022), which also hosts the extremely rare *Botrychium ascendens*, was proposed for a land exchange with Plum Creek Timber, but 160 acres were removed from the exchange to protect the moonworts (U.S. Forest Service 1995, 1996).
- I. **ASSESSMENT AND MANAGEMENT RECOMMENDATIONS**
  1. **THREATS TO CURRENTLY KNOWN POPULATIONS:** A subpopulation at French Creek (021) is included in a proposed timber sale and the status of the unit has not been resolved (L. Ferguson, pers. commun.). Most of the population area at Red Top Creek (038) was within a unit prescribed for a clearcut which had already been sold, but logging of the unit was discontinued five years ago when wildfires broke out nearby; the timber has since been bought back by the KNF and logging will not proceed (L. Ferguson, pers. commun.). Of the five largest known populations on the KNF, Zulu Creek (028) is protected as designated old growth and part of Kelsey Creek (025) is protected as a Botanical Special Interest Area, but the others are designated as suitable timberland (USDA Forest Service 1987). The boundaries of

the Kelsey Creek Botanical Area do not encompass a large portion of the population of *Botrychium minganense* and *B. montanum* and was erroneously established to protect *B. crenulatum* which does not occur at the site. Many of the occurrences of *B. minganense* located in 1996 are within proposed timber sale boundaries.

2. **MANAGEMENT PRACTICES AND RESPONSE:** Our searches for moonworts in a variety of habitats, including paired searches of altered habitat adjacent to known populations (Appendix A), demonstrate that *Botrychium minganense* on the KNF is primarily a species of maturing to old growth stands of western red cedar. Although the species is known to grow in second growth deciduous forests in Michigan (Wagner and Lord 1956) and was found in maturing second growth cedar on the KNF at Cedar Creek (027), it has not been found in recently logged areas or in units with young regeneration. It is likely that logging will at least temporarily eliminate the species from an area. Data on fire relations are somewhat contradictory (see discussion of associated vegetation above) but suggest that fire will also exclude moonworts from a site and this effect may be long lasting.
3. **MANAGEMENT SUMMARY:** The many populations of *Botrychium minganense* which were documented on the KNF in 1995 required that the state rank designated by the Montana Natural Heritage Program be elevated from S1 to S2S3 (Heidel 1996). With several more populations found in 1996, it is now recommended changed to S3. The species occurs in many but not all mature cedar stands and in a range of other moist habitats and there is a high probability that additional populations will be found on the KNF. Relatively few occurrences are known in Montana outside the KNF, however this may be an artifact of sensitive plant budgets and survey intensity.

In spite of these many recent discoveries retention of Forest Service Sensitive status and continued tracking by MTNHP is recommended at this time for the following reasons: 1) *B. minganense* often occurs in genus communities with other more rare species of moonworts and initial surveys have not always found all species which occupy a site. For example, at Houghton Creek (022) where *B. minganense* was reported, a follow-up survey located the rare *B. ascendens*. Likewise, *B. paradoxum* was found where *B. minganense* was known at Zulu Creek (028) and a state record of *B. pedunculatum* was located at South Fork Big Creek (046). The inadequacy of a single survey stems from survey intensity, the staggered phenology within and between species, and the possibility of plants remaining below ground in some years. 2) Misidentification of moonworts in the fan-leaved group is common. For example, the population of *B. crenulatum* at Chief Creek (009) was originally identified as *B. minganense*. 3) Taxonomic questions concerning the species remain. *Botrychium minganense* is a highly variable species and is viewed by many workers as a "garbage can" taxon. Western "*B. minganense*" may be distinct from the eastern taxon (W. H. Wagner, pers. commun.). Description of new moonwort species in the fan-leaved group is currently in progress (K. Ahlenslager, W. H. Wagner, pers. commun.). The

entity now considered *B. minganense* may be better considered as more than one cryptic taxa; genetic tests and additional taxonomic revision are awaited to resolve this confusion.

Populations with large numbers of *B. minganense* tend to harbor additional species of moonworts, thus conservation efforts should be focused on identifying and protecting these occurrences. The Botanical Special Interest Area at Kelsey Creek (025) protects part of a significant population of *B. minganense* and *B. montanum* but the boundaries do not contain the entire population. Significant genus communities with *B. minganense* at Can Creek (044), French Creek (021), Parsnip Creek (059), Red Top Creek (038), Sutton Creek (049), and Zulu Creek (028) should also be considered for designation as Special Interest Areas.



Mountain Moonwort  
*Botrychium montanum*

A. CLASSIFICATION

1. FAMILY: Ophioglossaceae, a family of primitive ferns
2. GENUS: *Botrychium* subgenus *Botrychium*
3. SPECIES: *Botrychium montanum* Wagner, described in Wagner and Wagner (1981).

B. PRESENT LEGAL OR OTHER FORMAL STATUS

1. FEDERAL
  - a. U.S. FISH AND WILDLIFE SERVICE: none
  - b. U.S. FOREST SERVICE: Sensitive in Region 1 (U.S. Forest Service 1994a).
  - c. BUREAU OF LAND MANAGEMENT: none
2. STATE: The Montana Natural Heritage Program ranks the species G3S2 (Heidel 1996), signifying that it is vulnerable to extinction throughout its range and imperiled in Montana.

C. DESCRIPTION

1. GENERAL NONTECHNICAL DESCRIPTION: *Botrychium montanum* is a small perennial fern with a single above ground frond. The frond varies in height up to about 12 cm tall, is a dull glaucous gray-green, somewhat succulent, and divided into two segments which share a relatively short common stalk. The sterile segment is once pinnatifid with well separated, irregular, angular, ascending lobes with entire or toothed margins. The fertile segment is longer than the sterile segment, is branched, and bears grape-like sporangia. Spores germinate underground and develop into minute subterranean, non-photosynthetic gametophytes. Photographic slides of the sporophytes from several KNF sites are provided in Appendix I.
2. TECHNICAL DESCRIPTION: "Trophophore stalk 0.3-2 cm, 0.2-0.5 times the length of the rachis; blade dull, glaucous, gray-green, mostly linear, lobed to 1-pinnate, to 6 X 0.7 cm, somewhat succulent. Pinnae or lobes to 6 pairs, ascending, mostly widely separated, distance between 1st and 2d pinnae not or slightly more than between 2d and 3d pairs, extremely variable in outline, linear to cuneate, undivided to tip, margins entire to coarsely dentate, distal pinnae or blade tip cut into 3-5 lobes,

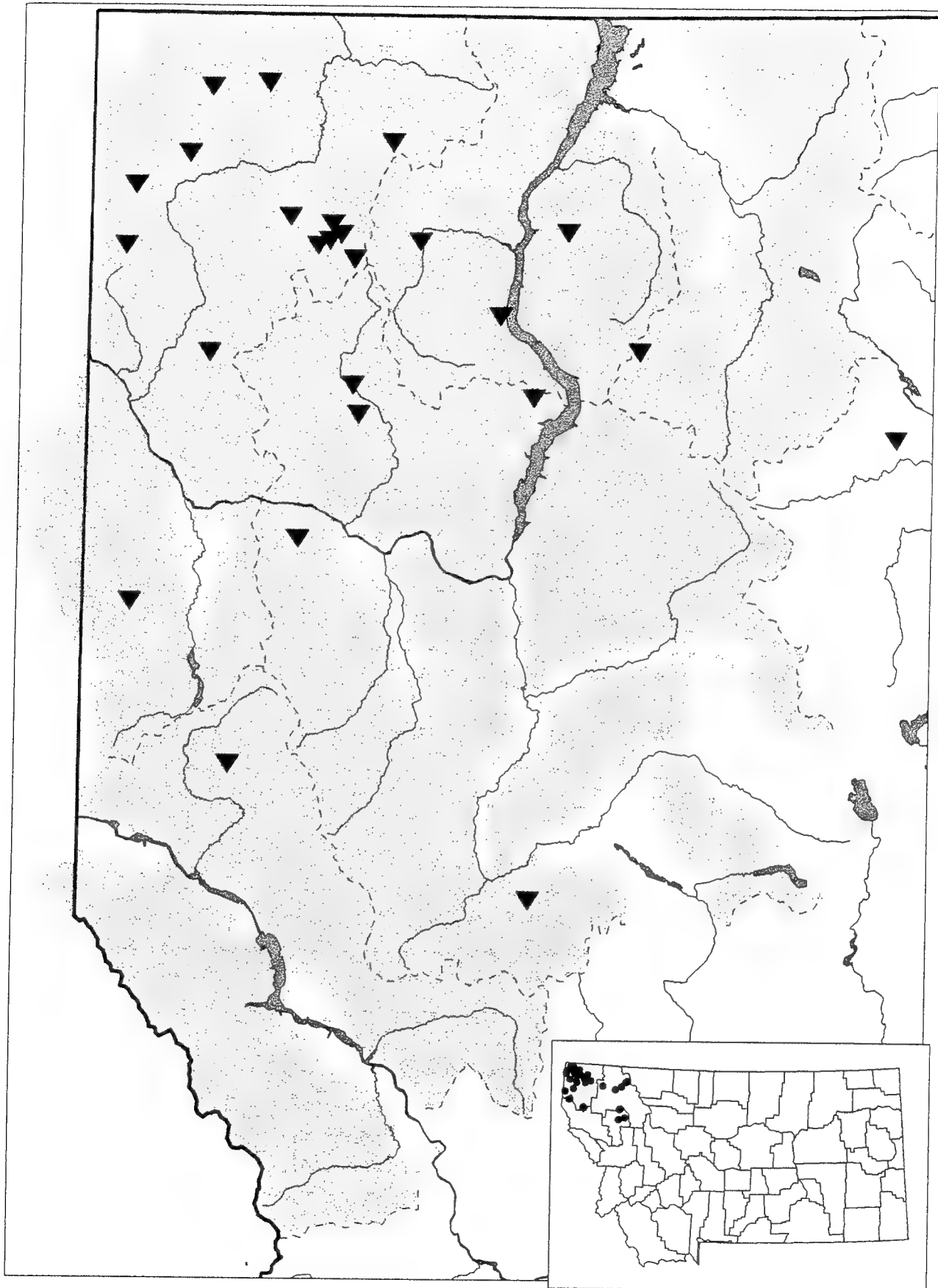
apex angular, venation like ribs of a fan, midrib absent. Sporophores 1-pinnate, 1.5-4.5 times length of sporophore.  $2n = 90$ ." (Wagner and Wagner 1993)

3. LOCAL FIELD CHARACTERS: Glaucous gray green color, succulent texture, a relatively short common stalk, and irregular angular lobes rather than distinct pinnae are diagnostic of *B. montanum*. Among the moonworts of Montana, *B. montanum* is relatively easily recognized, but may be mistaken for *B. ascendens* and small plants may be confused with other species.

#### D. GEOGRAPHICAL DISTRIBUTION

1. RANGE: Western North America; British Columbia, California, Montana, Oregon, Washington (Wagner and Wagner 1993, Idaho (Idaho Conservation Data Center, pers. commun.).
2. MONTANA DISTRIBUTION: *Botrychium montanum* is now documented in the Biological Conservation Database (BCD) from 31 sites in northwestern Montana in Flathead (4 occurrences), Lake (3 occurrences), Lincoln (23 occurrences) and Sanders (1 occurrence) counties (Figure 4 inset). In addition, while examining moonwort specimens at the herbarium of the University of Montana, I found 9 collections of *B. montanum* which were identified as *B. simplex* prior to the description of *B. montanum*. These are from Lake County and Glacier National Park and some are from locations already in the BCD and cited in the description of the species (Wagner and Wagner 1981). I annotated these specimens and put them in the *B. montanum* folder which was previously empty; those which represent new locations will be entered in the BCD.
3. OCCURRENCES ON THE KOOTENAI NATIONAL FOREST
  - a. CURRENT SITES: Prior to 1995, three occurrences of *B. montanum* were documented in the BCD, all in the drainage of Can Creek on the Three Rivers District. In 1995, these were relocated and 13 more populations were discovered, and in 1996, 8 more populations were found making a total of 24. There are known occurrences on all Districts but most are in the northwestern part of the Forest on the Three Rivers District (Table 1). Figure 4 shows the approximate locations of the occurrences on the KNF. Element Occurrence Records and topographic maps showing the precise locations are given in Appendix B.
  - b. HISTORICAL SITES: none
  - c. UNVERIFIED/UNDOCUMENTED SITES: none
  - d. AREAS SURVEYED BUT SPECIES NOT LOCATED: See Appendix A for a list of areas on the KNF which I surveyed for moonworts.

**Figure 4. *Botrychium montanum* -- Mountain Moonwort**  
Occurrences on or near the Kootenai National Forest, Montana



## HABITAT

1. ASSOCIATED VEGETATION: Wagner and Wagner (1981) state that "it is most abundant in moist, springy western red cedar (*Thuja plicata*) forests." They also report the species from a high elevation grassy trailside at Logan Pass. Nearly all Montana, Idaho (Idaho Conservation Data Center, pers. commun.), and Washington (Washington Natural Heritage Program, pers. commun.) occurrences are in *Thuja plicata* or *Tsuga heterophylla* habitat types. In Oregon, the species has been found in 10 year old clearcuts with regeneration on the Umatilla National Forest (D. Pavsek, pers. commun.) and in partially shaded mesic meadows in the Wallowa Mountains (Zika and Alverson 1996).

Most of the sites on the KNF are in maturing to old growth western red cedar stands. Habitat types include *Thuja plicata*/*Clintonia uniflora*, *Thuja plicata*/*Oplopanax horridum*, *Thuja plicata*/*Athyrium filix-femina*, and *Tsuga heterophylla*/*Clintonia uniflora* (Cooper et al. 1991, Pfister et al. 1977). Average tree age of the dominant layer in 9 forested Ecodata plots with *B. montanum* (Appendix C) ranges from 49 to 210 years. At Berray Mountain (017), where *B. montanum* was the only moonwort found, some ancient cedars are probably over 1,000 years old. At Cedar Creek (014) *B. montanum* grows in second growth cedar in an area that burned in the early 1900's, at Can Creek (011) part of a population grows under a dense canopy of pole sized seral conifers (*Picea* and *Abies* sp.), and at Pipe Creek (016) a few plants grow on an old skidtrail. Clearcuts of the same habitat type and topography as and adjacent to *B. montanum* populations were searched at Clay Mountain (019) and Red Top Creek (022) but no moonworts were found. In 1996, a single *B. montanum* plant was found in an anomalous habitat for the KNF at Houghton Creek (026) where it grows nearby *B. ascendens* in a shrub dominated wetland.

Canopy cover in the cedar habitats is usually high, while ground cover by forbs and graminoids is usually low. Understory vascular plant species with high constancy (>50%) in sampled Ecodata plots (Appendix C) include *Actaea rubra*, *Athyrium filix-femina*, *Botrychium minganense*, *B. virginianum*, *Chimaphilla umbellata*, *Clintonia uniflora*, *Galium triflorum*, *Goodyera oblongifolia*, *Gymnocarpium dryopteris*, *Linnaea borealis*, *Orthilla secunda*, *Rosa woodsii*, *Rubus parviflorus*, *Smilacina stellata*, *Streptopus amplexifolius*, *Tiarella trifoliata*, and *Trillium ovatum*. On the KNF, *Botrychium montanum* grows by itself and with the other moonworts *B. ascendens*, *B. lanceolatum*, *B. minganense*, *B. pinnatum*, and *B. pedunculatum*.

*Botrychium montanum* is often the only plant growing in dense litter of cedar leaves in deep shade, but also grows among mosses. Closely associated mosses include species of *Aulacomnium*, *Brachythecium*, *Dicranum*, *Eurhynchium*, *Mnium*, *Plagiomnium*, *Pleurozium*, *Prilium*, *Rhizomnium*, *Rhytidiopsis*, *Roellia*, *Sanionia*, and *Timmia* (Appendix G).

Additional information on associated vegetation on the KNF is described in the general site description fields of the Element Occurrence Records in Appendix B and in the Ecodata tables in Appendix C. Photographic slides of the vegetation at several sites are provided in Appendix I.

2. TOPOGRAPHY: Throughout Montana, *Botrychium montanum* occurs in the western mountains at elevations ranging from 2,960 to 6,000 feet. On the KNF it grows in glaciated stream bottoms and in swales, draws and on benches of glaciated slopes at elevations ranging from 2,600 to 4,950 feet. The species is usually associated with small hydrological features such as seeps, rivulets, draws, and swales and the microtopography is usually level or patterned.
3. SOIL RELATIONSHIPS: *Botrychium montanum* almost always grows in organic substrates, usually composed of cedar (*Thuja plicata*) leaves or decomposed wood. At West Pipe (013) it also grew in partially decomposed layers of alder (*Alnus* sp.) leaves. These organic substrates are expected to be acidic (L. Kuennen, pers. commun.) although ground water and underlying soils at some sites may be calcareous. Most sites are within landtype 352 (Kuennen and Gerhardt 1984) which has underlying soils derived from volcanic ash-influenced loess overlying dense glacial till. Calcareous groundwater may occur in the Can Creek (009, 010, 011) and Zulu Creek (015) drainages whose headwaters are within the Helena formation geological mapping unit (Harrison et al. 1992) composed of dolomites and dolomitic siltites; calcium laden seeps were observed at Can Creek. At West Pipe (013) the soils and groundwater are also likely to be calcareous as the site is within landtype 329 (Kuennen and Gerhardt 1984).

Although they often grow nearby, *Botrychium montanum* and *B. minganense* have discrete microhabitat preferences which differ in substrate characteristics, *B. montanum* usually growing in somewhat dryer microsites. At French Creek (020) *B. montanum* grows mostly on the uphill side of a seep while *B. minganense* is concentrated on the downhill side. *Botrychium montanum* has been observed growing in lines down moss covered, decomposed, buried logs. These observations suggest that its distribution is controlled by substrate composition and moisture, possibly related to the presence of a fungal symbiont.

4. CLIMATE FACTORS: *Botrychium montanum* is most common in relatively low elevation areas in northwestern Montana with maritime influenced climates which support western red cedar; average annual precipitation in these habitats is 32 inches or more (Pfister et al. 1977). On the KNF, the species is mostly confined to the wetter, western part of the Forest. Climatic fluctuations may dramatically effect the phenology and numbers of moonwort sporophytes which produce above ground leaves in a growing season; in dry years fewer plants can be expected to be found and the length of the growing season is expected to be shorter.

## F. POPULATION DEMOGRAPHY AND BIOLOGY

1. PHENOLOGY: Wagner and Wagner (1993) state that leaves appear from late spring to late summer. Data from monitoring transects at French Creek (020) show that *Botrychium montanum* has a staggered phenology of frond emergence (see results section). Individual plants of *Botrychium montanum* and *B. minganense* were mapped and measured in permanent belt transects in mid-July and again in early-September of 1995 and 1996. At the latter date in both years some fronds of both species had disappeared, some were nibbled, others had grown larger, and new fronds had emerged. *Botrychium montanum* has an later phenology than its often close associate *B. minganense*. Plants observed in September at French Creek (020) and Sutton Creek (004) still had mostly indehiscent sporangia.
2. POPULATION SIZE AND CONDITION: Wagner and Wagner (1981) state that "a single locality may have hundreds of plants in a small area." High population numbers and densities were observed on the KNF at French Creek (020, see the general results section and Appendix D), Kelsey Creek (012), and Sterling Creek (028) but most populations had less than 100 plants and 12 populations had less than 20 plants.
3. REPRODUCTIVE BIOLOGY: See discussion of life history following the Introduction of this report. *Botrychium montanum* has recently been shown to be capable of vegetative reproduction by underground sporophytic gemmae (Camacho 1996 and pers. commun., see results section). Vegetative reproduction may be responsible for the high densities often observed in populations of this species.

## G. POPULATION ECOLOGY

1. COMPETITION: *Botrychium montanum* is often the only plant growing in deep duff layers under heavy cedar canopies. These habitats have high competition for light, but low root zone competition. Increased competition may be a factor in the apparent exclusion of *Botrychium montanum* and *B. minganense* from a clearcut at Red Top Creek (022). Ecodata plots were sampled in the moonwort habitat and in a swale within the clearcut without moonworts (Appendix C). The most obvious differences between these paired plots are 1) decreased canopy cover by trees in the clearcut 2) increased ground cover by wood and a corresponding decrease in litter cover in the clearcut, and 3) increased cover (competition) by shrubs, forbs, graminoids, ferns, and mosses in the clearcut.

The occurrence of moonworts, including *Botrychium montanum*, in genus communities seems to run counter to the competitive exclusion principle, however, plant densities are usually so low that competition between moonwort species is not expected. Our observations also suggest that the individual species do have subtly different microhabitat preferences (see discussion of soil relationships above).

2. **POSITIVE INTERACTIONS:** All *Botrychium* species are believed to be obligately dependent on mycorrhizal relationships in both the gametophyte and sporophyte generations. See the discussion of mycorrhizal relations following the introduction of this report. The high habitat fidelity of *B. montanum* to cedar habitat types and its local distribution along buried logs suggests it is associated with a fungus associated with these habitats.
  3. **HERBIVORY:** Nibbled sporophores and sometimes entire plants of *Botrychium montanum* were observed at several sites and were quantified at French Creek (see Results section and Appendix D). Often the sporophore is selectively browsed leaving the trophophore intact. Small animals, possibly rabbits, rodents, or snails, may play a role in spore dissemination (Zika 1992). One plant of *B. montanum* was observed in which "pruning" by nibbling apparently caused abnormal regrowth of the moonwort with sporangia borne on the trophophore.
- H. **LAND OWNERSHIP:** All occurrences in the vicinity are on the Kootenai National Forest.
- I. **ASSESSMENT AND MANAGEMENT RECOMMENDATIONS**
1. **THREATS TO CURRENTLY KNOWN POPULATIONS:** A subpopulation at French Creek (020) was included in a proposed timber sale and the status of this unit is unresolved (L. Ferguson, pers. commun.). The population at Red Top Creek (022) lies within a unit prescribed for a clearcut which was sold, but logging of the unit was discontinued five years ago when wildfires broke out nearby; since then, the standing timber has been bought back by the KNF and logging will not proceed (L. Ferguson, pers. commun.). Several populations were found in proposed cutting units in 1996.
  2. **MANAGEMENT PRACTICES AND RESPONSE:** Clearcuts of the same habitat type and topography as and adjacent to *Botrychium montanum* populations were searched at Clay Mountain (019) and Red Top Creek (022) but no moonworts were found. The species appears to have a high fidelity to cedar habitats with high canopy cover and deep litter layers and it is expected that disturbance by logging and/or fires will at least temporarily exclude it from an area. It has been found in an old logged and burned area at Cedar Creek (014) and in an old skid trail at Pipe Creek (016); both sites have reestablished canopy and litter cover. At Sterling Creek (028) *B. montanum* is frequent in the oldest groves but drops out in adjacent younger late seral stands although shade regime is the same (T. Spribille, pers. commun.). On the KNF *Botrychium montanum* is probably adapted to middle to late seral stages of cedar and hemlock habitat types. In contrast, the species occurs in 10 year old clearcuts on the Umatilla National Forest in Oregon (D. Pavek, pers. commun.).
  3. **MANAGEMENT SUMMARY:** Current State rank (S2) and Forest Service Sensitive status remain appropriate. Although high population numbers and densities were

observed at some sites on the KNF and are reported elsewhere (Wagner and Wagner 1981) most populations on the KNF are small. Most of the largest populations are in management areas designated as suitable timberland (U.S. Forest Service 1987). Many populations of *Botrychium montanum* are on forested slopes or at topographical and hydrological microfeatures not protected by standard riparian guidelines (U.S. Forest Service 1994b). Clearcutting or burning a population area is likely to extirpate the species from the site at least temporarily but it may be able to recolonize maturing second growth.

Conservation management should prioritize large populations and genus communities. The Botanical Special Interest Area (Management Area Maps, Kootenai National Forest, Libby) at Kelsey Creek (012) protects part of a significant population of *B. minganense* and *B. montanum* but the boundaries do not contain the entire population. The Clay Mountain (019) and Berray Mountain (017) populations are also protected as Botanical Special Interest Areas but few plants were found at these sites in 1995. Significant genus communities with *B. montanum* at South Fork Big Creek (029), Can Creek (011), French Creek (021), Parsnip Creek (030), Red Top Creek (038), Sterling Creek (028), Sutton Creek (024), and Zulu Creek (028) should also be considered candidates for designation as Special Interest Areas.



Peculiar Moonwort  
*Botrychium paradoxum*

A. CLASSIFICATION

1. FAMILY: Ophioglossaceae, a family of primitive ferns
2. GENUS: *Botrychium* subgenus *Botrychium*
3. SPECIES: *Botrychium paradoxum* Wagner, described in Wagner and Wagner (1981).

B. PRESENT LEGAL OR OTHER FORMAL STATUS

1. FEDERAL

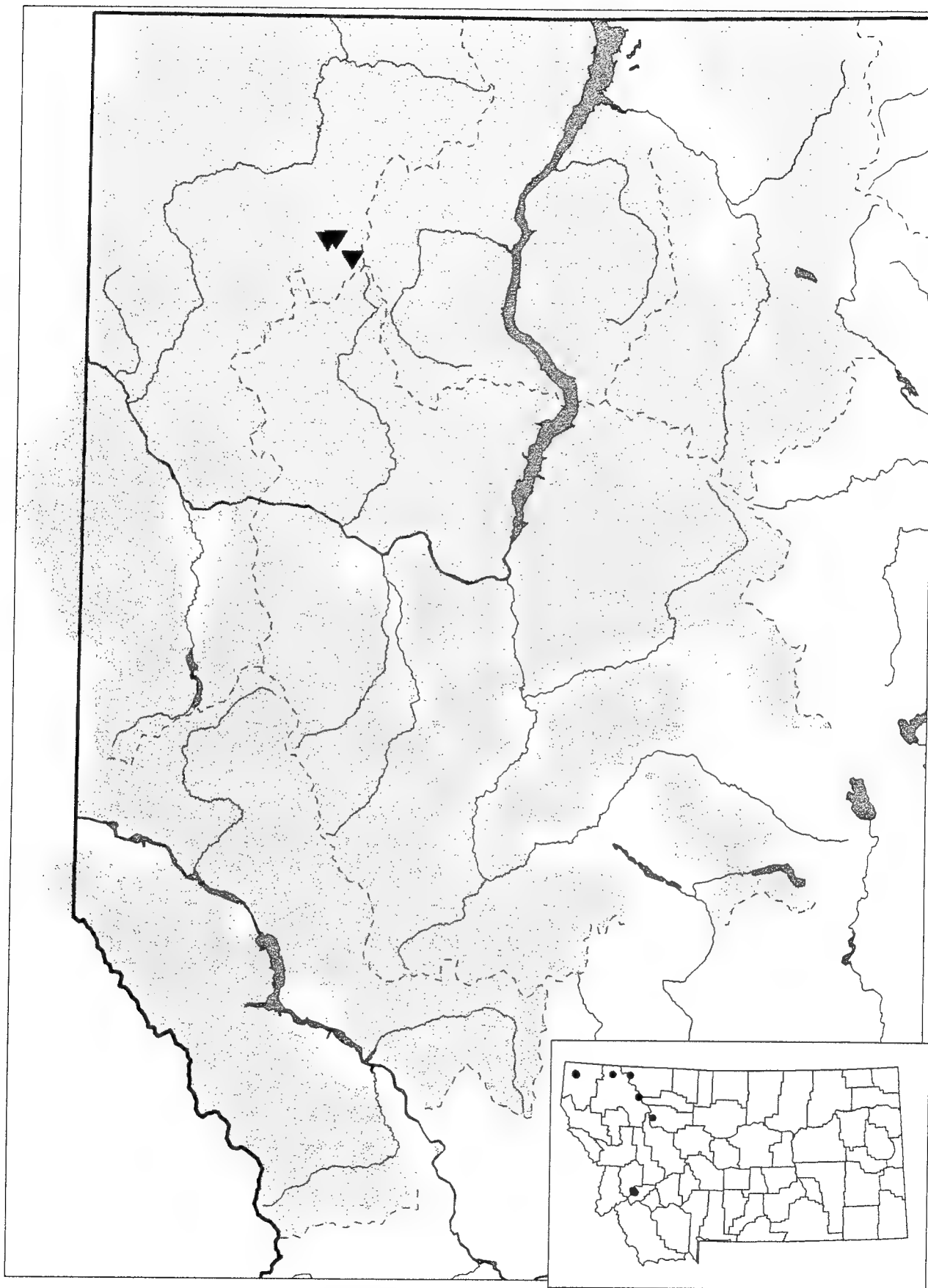
- a. U.S. FISH AND WILDLIFE SERVICE: Previously recognized as C2 (U.S. Dept. of Interior 1993), indicating that it was a species "for which information now in the possession of the Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which sufficient data on biological vulnerability and threat are not currently available to support proposed rules." Recognition of C2 species was officially discontinued by the Service in 1996 (U.S. Fish and Wildlife Service 1996).
  - b. U.S. FOREST SERVICE: Sensitive in Region 1 (U.S. Forest Service 1994a).
  - c. BUREAU OF LAND MANAGEMENT: none
2. STATE: The Montana Natural Heritage Program ranks the species G2 and S1 (Heidel 1996), indicating that it is imperiled because of rarity throughout its range and critically imperiled due to extreme rarity in Montana.

C. DESCRIPTION

1. GENERAL NON-TECHNICAL DESCRIPTION: *Botrychium paradoxum* is a small perennial fern with a single above ground frond. The frond varies in height up to about 15 cm tall, is glaucous green, somewhat succulent, and divided into two similar segments which share a common stalk. The segments may be unbranched in small plants or branched in larger plants and are both fertile and bear grape-like sporangia. Spores germinate underground and develop into minute, subterranean, non-photosynthetic gametophytes. A photographic slide (# 40) of a plant from Zulu Creek (010) is provided in Appendix I.

2. TECHNICAL DESCRIPTION: "Trophophores converted entirely to second fertile segment, stalk 1/2 length of fertile segment. Sporophores double, 2 per leaf, 1-pinnate, 0.5-4 cm.  $2n = 180$ ." (Wagner and Wagner 1993)
  3. LOCAL FIELD CHARACTERS: *Botrychium paradoxum* is perhaps the easiest of moonworts to recognize, being the only species to lack a sterile laminar frond segment, but other species could be mistaken for it if the sterile segment has been browsed or bears marginal sporangia.
- D. GEOGRAPHICAL DISTRIBUTION
1. RANGE: Alberta, British Columbia, Saskatchewan, Montana, and Utah (Wagner and Wagner 1993), Oregon (Zika 1992), Washington (Washington Natural Heritage Program, pers. commun.).
  2. MONTANA DISTRIBUTION: There are currently ten records of *Botrychium paradoxum* in the Biological Conservation Database (Figure 5 inset). These include one population from the Rocky Mountain Front Range (Teton County), three populations in the Anaconda Range (Granite and Deer Lodge Counties), three populations in or near Glacier National Park (Flathead, Glacier, and Pondera Counties), and three populations in the Purcell Range (Lincoln County). The record from Marias Pass near Glacier Park could not be relocated by a survey in 1986.
  3. OCCURRENCES ON THE KOOTENAI NATIONAL FOREST
    - a. CURRENT SITES: *Botrychium paradoxum* has been found at three nearby sites on the Three Rivers District at Can and Zulu Creeks (Figure 5). The species could not be relocated in 1995 at the two Can Creek sites where it was first seen on the Forest in 1993. It was found in 1995 at Zulu Creek where other moonworts were previously known. The Zulu Creek occurrence is represented by a specimen (deposited at MONTU) and a photograph (slide #40 in Appendix I). Exhaustive surveys were conducted at all three sites in 1996 but no *B. paradoxum* plants were relocated.
    - b. HISTORICAL SITES: none
    - c. UNVERIFIED/UNDOCUMENTED REPORTS: The two Can Creek occurrences could not be relocated in 1995 or 1996 by thorough searches of the entire drainage and are not documented by specimens or photographs. However, the species is not easily mistaken for other moonworts and the reports are believed to be accurate (L. Ferguson, pers. commun.).
    - d. AREAS SURVEYED BUT SPECIES NOT LOCATED: See Appendix A for a list of areas which I searched for moonworts.

**Figure 5. *Botrychium paradoxum* -- Peculiar Moonwort**  
Occurrences on or near the Kootenai National Forest, Montana



## E. HABITAT

1. ASSOCIATED VEGETATION: The habitats of *Botrychium paradoxum* throughout its range are diverse, but most sites outside the Kootenai National Forest are montane to sub-alpine grasslands or forb dominated meadows. In the Anaconda Range where the species is known in most abundant numbers, it grows in grasslands dominated by *Festuca scabrella*, *Festuca idahoensis*, and *Carex raynoldsii* (Vanderhorst 1993). *Fragaria virginiana* is a conspicuous close associate at the Anaconda Range sites and in the Wallowa Mountains in Oregon (Zika 1992). The open grassland habitats are described as sunny (Wagner 1981, Zika 1992, 1994), but in the Anaconda Range, *B. paradoxum* grows in the shade of dense cover of tall bunchgrasses. The vegetation at the Marias Pass site was a dense stand of *Epilobium angustifolium* (fire weed). In the Rocky Mountain Front Range the habitat is dominated by seral forbs. In 1996, Peter Lesica found a population in Glacier National Park in an area burned in 1988, now dominated by native fescue bunchgrasses. In Utah the species was collected from subalpine "meadows" (Utah Natural Heritage Program, pers. commun.) and in Oregon all occurrences are in mesic meadows (Zika 1994). In Washington it grows in meadows and in forests (Washington Natural Heritage Program, pers. commun.) Wagner and Wagner (1993) state that *B. paradoxum* usually grows "in snowfields and secondary growth pastures."

Vegetation at the three locations of *B. paradoxum* on the Kootenai National Forest is a marked contrast to the open habitats described above. Here the species grows in *Tsuga heterophylla*/*Clintonia uniflora* (western hemlock/queencup beadlily) and *Thuja plicata*/*Clintonia uniflora* (western red cedar/queencup beadlily) habitat types (Phister et al. 1977, Cooper et al. 1991). *Botrychium paradoxum* has also been found in cedar and hemlock habitat types in Washington (Washington Natural Heritage Program, pers. commun.).

The three KNF sites were sampled by Ecodata plots (Appendix C), but the locations of the plots at the Can Creek sites only approximate the precise locations of the rare moonwort which was not seen in the year of sampling. Canopy cover at the sites, contributed mostly by *Thuja plicata*, ranges from 70-90% and average age of the dominant tree layer ranges from 120-210 years. *Tsuga heterophylla* is successfully reproducing in the Can Creek plots and *Picea* is present in all three plots. There is little cover by shrubs, but *Ribes lacustre* and the subshrub *Linnaea borealis* occur at all three sites. Vegetative ground cover is low to moderate, dominated by forbs and mosses. Forbs present at all three sites include *Actaea rubra*, *Chimaphilla umbellata*, *Clintonia uniflora*, *Galium triflorum*, *Streptopus amplexifolius*, and *Trillium ovatum*. The fern *Botrychium virginianum* is present at all sites. In a microplot at Zulu Creek (Appendix C) *B. paradoxum* grew in immediate association with *Botrychium minganense*, *B. virginianum*, *Tiarella trifoliata*, and *Viola glabella*.

On the KNF, *Botrychium paradoxum* has been found growing with the other moonworts *B. minganense*, *B. montanum*, and *B. pinnatum*. Throughout its range, *B. paradoxum* has been reported growing with *B. hesperium*, *B. lanceolatum*, *B. lunaria*, *B. minganense*, *B. pinnatum*, *B. pedunculatum* and *B. simplex* (Vanderhorst 1993, Wagner and Wagner 1983, Zika 1992).

Associated vegetation of the three Kootenai National Forest sites is described in detail in the general site description fields of the Element Occurrence Records in Appendix B and in the Ecodata tables in Appendix C. A photographic slide of the vegetation at Zulu Creek is provided in Appendix I.

2. TOPOGRAPHY: In Montana, *Botrychium paradoxum* grows on glaciated slopes and ridgetops, and in glaciated lake basins, stream bottoms and draws at elevations ranging from 3,700 to 8,400 feet. On the Kootenai National Forest, the known sites are in west facing drainages of tributaries of the South Fork Yaak River at elevations ranging from 3,700 to 4,600 feet. Two sites are in flat stream bottoms and the third is in a gently sloping draw with an ephemeral stream and seeps. Microtopography of the sites is patterned, caused by windthrow hummocks, old rotten logs, and streamlet channeling.
3. SOIL RELATIONSHIPS: On the Kootenai National Forest, the Can Creek sites (008, 009) are within landtype 352 and the Zulu Creek (010) site is in landtype 357. Soils from both these landtypes are described as "formed in volcanic ash-influenced loess overlying dense glacial till" (Kuennen and Nielsen-Gerhardt 1995). However, the plants grow in thick layers of litter or humus rather than in soil, and the underlying soils of the riparian microhabitats are influenced by alluvial deposition. At Zulu Creek, the single plant grew in wet duff next to a rivulet. The duff layers are expected to be acidic because they are derived from conifer, mostly cedar, leaves (L. Kuennen, pers. commun.), however, ground water at the sites may be calcareous. Headwaters of the two drainages are within the Helena formation geological mapping unit composed of dolomites and dolomitic siltites (Harrison et al. 1992), which is associated with calcareous soils in the eastern part of the Forest; limy seeps and rivulets were observed in the upper drainage of Can Creek. Limestone parent materials are also reported from sites in the Anaconda Range (Vanderhorst 1993) and possibly from the Wallowa Mountains in Oregon (Zika 1992, 1994). Soils of the meadow habitats in the Anaconda Range have a thin litter layer and a high organic fraction in the upper horizons (Vanderhorst 1993).
4. CLIMATE FACTORS: The known occurrences of *Botrychium paradoxum* on the KNF are at relatively high elevations in the Upper Yaak Valley, an area of the Forest which has heavy precipitation and snow accumulation. Moonworts in general are adapted to cool, moist climates. In Montana they are thus most common at low elevations in the northwest part of the state with its cool temperate, maritime influenced climate, while in semi-arid regions of the state (e.g. Granite, Deer Lodge,

and Lewis and Clark counties) they are confined to higher elevations which receive heavy accumulations of snow. Climatic fluctuations may dramatically effect the phenology and numbers of moonwort sporophytes which produce above ground leaves in a growing season; in dry years fewer plants can be expected to be found and the length of the growing season is expected to be shorter.

#### F. POPULATION DEMOGRAPHY AND BIOLOGY

1. PHENOLOGY: Montana populations have been located in late June to early August when they have generally had immature sporangia. Spore dispersal probably occurs in July through September. Warm, dry weather is likely to shorten the growing season and speed development of the plants.
2. POPULATION SIZE AND CONDITION: The known "populations" on the Kootenai National Forest are very small, with only a single plant found at each site. *Botrychium paradoxum* was not relocated by surveys of the Can Creek drainage in 1995 or 1996, or by surveys of Zulu Creek in 1996. "Populations" of one plant are likely to be ephemeral. At Marias Pass, 45 plants were observed in 1978, but the population could not be relocated in 1986. The occurrence in the Rocky Mountain Front Range was reported to consist of 30 plants in 1989. In 1996, Peter Lesica found a population in Glacier National Park estimated to consist of 100 or more plants. The species is more abundant in Montana in the Anaconda Range where populations consist of hundreds and perhaps even thousands of plants (Vanderhorst 1993). The populations in the Wallowa Mountains in Oregon are also very small (Zika 1992, 1994) and all but one of the seven reported Washington sites (Washington Natural Heritage Program, pers. commun.) had fewer than ten plants.

Lesica and Ahlenslager (1996) conducted demographic studies of a population which included *Botrychium paradoxum*, *B. hesperium*, and their putative hybrid *B. X watertonense* in Waterton Lakes Park, Alberta. Of the three taxa, *B. paradoxum* had the highest rates of mortality and recruitment, and they suggest that "it is the most adapted to ephemeral habitats and is the most prone to cycles of extinction and recolonization."

3. REPRODUCTIVE BIOLOGY: See discussion of life history following the Introduction of this report.

#### G. POPULATION ECOLOGY

1. COMPETITION: The occurrence of moonworts, including *Botrychium paradoxum*, in genus communities seems to run counter to the competitive exclusion principle, however, plant densities are usually so low that competition between moonwort species is not expected. Furthermore, our observations suggest that the individual species have subtly different microhabitat preferences. At Zulu Creek (010),

however, several plants of *B. minganense* grew within inches of a single plant of *B. paradoxum* in apparently equivalent habitat, suggesting that *B. minganense* may have a competitive advantage over *B. paradoxum* in this habitat. The opposite may be true at Cub Ridge in the Anaconda Range, where *B. paradoxum* is the dominant moonwort and only a few plants of *B. minganense* were found (Vanderhorst 1993).

The effects of competition from other types of plants is not known, but data from the single microplot with *Botrychium paradoxum* at Zulu Creek (Appendix C) suggest that competition for light may be a factor in the plants poor reproductive success. In this plot there was high canopy cover and very high ground cover by forbs and ferns taller than *B. paradoxum*. The single plant of the moonwort was etiolated and had few sporangia compared to the robust individuals observed in the Anaconda Range. Demographic data from Lesica and Ahlenslager (1984) suggest that *B. paradoxum* may be favored by some disturbance due to the sporophytes short life and poor competitive ability.

- b. **POSITIVE INTERACTIONS:** All *Botrychium* species are believed to be obligately dependent on mycorrhizal relationships in both the gametophyte and sporophyte generations. See the discussion of mycorrhizal relations following the Introduction of this report. Zika (1992) reported an abundance of *Fragaria virginiana* (strawberry) in *B. paradoxum* habitat in Oregon and I observed the same association in the Anaconda Range (Vanderhorst 1993). These relationships may be a manifestation of mycorrhizal links between these plants.
- c. **HERBIVORY:** Herbivory of *Botrychium paradoxum* was not observed, but nibbled sporophores of other species of moonworts was noted on the KNF in 1995 and 1996. The clusters of sporangia are often selectively browsed. Small animals, possibly rabbits, rodents, or snails may play a role in spore dispersal of moonwort species (Zika 1992).
- H. **LAND OWNERSHIP:** All three known occurrences of *Botrychium paradoxum* in the vicinity are on KNF land on the Three Rivers District.
- I. **ASSESSMENT AND MANAGEMENT RECOMMENDATIONS**
  - 1. **THREATS TO CURRENTLY KNOWN POPULATIONS:** The extremely low numbers of *Botrychium paradoxum* at its sites on the KNF raise questions about population viability even under unaltered conditions. None of the occurrences could be relocated in years following their discovery although thorough surveys were conducted in 1995 and 1996. The draw and creek bottom where the species was found at Can Creek have intact native forests, but the area is designated as suitable timberland (USDA Forest Service 1987) and surrounding slopes have been extensively logged. The long term effects of logging on the hydrology at the sites is not known. The Zulu Creek (010) site is designated old growth (USDA Forest Service 1987). In

order to positively document the occurrence of the species from the KNF, a wide disjunction and in unusual habitat, the year's aerial leaf of the single plant at Zulu Creek was collected in 1995. However, collection of a species which occurs in such low numbers may significantly threaten its occurrences; apparently the plant did not produce an above ground frond in 1996.

2. MANAGEMENT PRACTICES AND RESPONSE: unknown
3. MANAGEMENT SUMMARY: *Botrychium paradoxum* is probably one of the most rare species in its genus, globally, within Montana, and especially on the KNF. Populations with large numbers have been reported in Montana only from the Anaconda Mountains, and some other populations could not be relocated in years following their discovery and may be extirpated. Current status designations by the U.S. Forest Service as sensitive, and by the Montana Natural Heritage Program as G2 and S1 remain appropriate. Protection of a single plant, as *B. paradoxum* has been found on the KNF, is nearly impossible, and alternative approaches are required. Since the species is usually found in genus communities, protection of these occurrences, whether or not *B. paradoxum* has been found at that particular site in a particular year, may be the best strategy for maintaining potential habitat for the rare species. This is an important reason for retaining the Forest Service sensitive status for the relatively more common moonworts *B. minganense* and *B. montanum*. Sites where *B. paradoxum* has been documented (Can Creek .008, .009, Zulu Creek .010) should be given high conservation priority and further surveys of these sites, other known genus communities, and additional unsurveyed areas for this species should continue. The site of a large population of *B. paradoxum* on Cub Ridge (locally called "Windy Ridge" ) in the Anaconda Range on the Deerlodge National Forest has been designated a Research Natural Area (J. Joy, pers. commun.) and this site may be crucial in providing a source of spores for long distance migration of the species.



Stalked Moonwort  
*Botrychium pedunculosum*

A. CLASSIFICATION

1. FAMILY: Ophioglossaceae, a family of primitive ferns
2. GENUS: *Botrychium* subgenus *Botrychium*
3. SPECIES: *Botrychium pedunculosum* Wagner, described in Wagner and Wagner 1986)

B. PRESENT LEGAL OR OTHER FORMAL STATUS

1. FEDERAL
  - a. U.S. FISH AND WILDLIFE SERVICE: Previously recognized as C2 (U.S. Dept. of Interior 1993), indicating that it was a species "for which information now in the possession of the Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which sufficient data on biological vulnerability and threat are not currently available to support proposed rules." Recognition of C2 species was officially discontinued by the Service in 1996 (U.S. Fish and Wildlife Service 1996).
  - b. U.S. FOREST SERVICE: Proposed sensitive in Region 1. The species was found for the first time in the Region in 1996 and so was not previously listed.
  - c. BUREAU OF LAND MANAGEMENT: none
2. STATE: *Botrychium pedunculosum* will be added to the list of plant species of special concern maintained by the Montana Natural Heritage Program and accorded a state rank of S1, indicating it is critically imperiled due to extreme rarity in Montana. It has a global rank of G3? (Oregon Natural Heritage Program 1995) indicating it is vulnerable due to rarity throughout its range.

C. DESCRIPTION

1. GENERAL NON-TECHNICAL DESCRIPTION: *Botrychium pedunculosum* is a small perennial fern with a single above ground frond. The frond varies in height up to about 20 cm and is divided into two segments which share a common stalk. The lower common stalk is usually reddish brown and the upper part of the plant is a dull glaucous green. The mostly sterile segment is conspicuously stalked and once to twice pinnatifid with up to five pairs of primary pinnae. The pinnae have irregular angular lobes and vary from pinnatifid to bifid to narrowly fan shaped and the lower

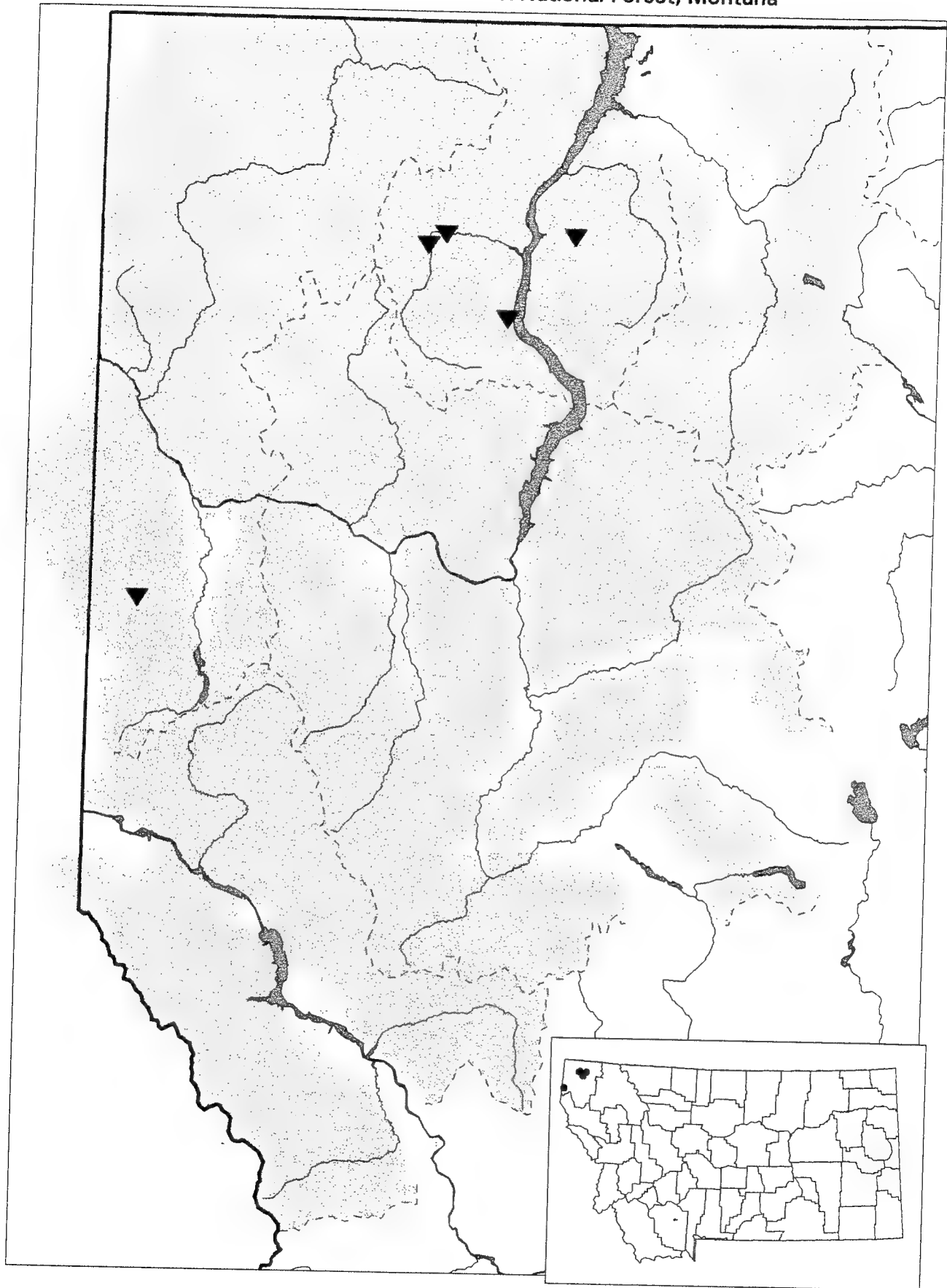
ones often bear sporangia. The fertile segment is longer than the sterile segment and bears grape-like sporangia; larger plants usually have two large ascending lateral branches. Spores germinate underground and develop into minute, subterranean, non-photosynthetic gametophytes. Photographic slides of the sporophytes are provided in Appendix I.

2. TECHNICAL DESCRIPTION: "Trophophore stalk 8-26 mm, to 1.1 times length of trophophore rachis; blade dull green, ovate-oblong to deltate-oblong, 1-pinnate, to 4.5 X 2 cm, leathery. Pinnae to 5 pairs, somewhat ascending, approximate to well separated, distance between 1st and 2d pinnae not or slightly more than between 2d and 3d pairs, basal pinnae pair approximately equal in size and cutting to adjacent pair, ovate-rhombic to spatulate, lobed to tip, margin entire to irregularly lobed, apex rounded to acute, venation pinnate. Sporophores 1-3 pinnate, 2-4 times length of trophophore.  $2n = 180$ ." from Wagner and Wagner 1993.
3. LOCAL FIELD CHARACTERS: *Botrychium pedunculosum* is a distinctive species which is most similar to *B. pinnatum* and *B. hesperium*, both species which may also have reddish common stalks and pinnatifid pinnae. It differs from the former by having a stalked trophophore, dull green vs. bright green color, and leathery vs. papery texture. *Botrychium hesperium* is also dull green, but the trophophore does not have a long stalk and the lowest pinnae pair are conspicuously larger than the adjacent pair. The presence of extra sporangia on the basal pinnae of the trophophore and the two large lateral branches of the sporophore are useful characters for identifying *B. pedunculosum*. A narrow brown stripe extending down the common stalk from the trophophore is mentioned in the description of the species (Wagner and Wagner 1986), but this character was not apparent on plants found on the KNF. Plants found on the KNF are shade forms (W. Wagner, pers. commun.) and have narrower pinnae which are more well separated than typical plants from Oregon, which grow in sunny places.

#### D. GEOGRAPHICAL DISTRIBUTION

1. RANGE: Western North America; Alberta, Saskatchewan, Oregon (Wagner and Wagner 1993), Washington (Washington Natural Heritage Program, pers. commun.), Montana.
2. MONTANA DISTRIBUTION: *Botrychium pedunculosum* was found for the first time in the state in 1996; all known occurrences are in Lincoln County on the KNF.
3. OCCURRENCES ON THE KOOTENAI NATIONAL FOREST
  - a. CURRENT SITES: Five small populations were found in 1996. Four sites are on the Rexford District in creeks draining into Lake Koocanusa (Big Creek .005, South Fork Big Creek .001, Parsnip Creek .002, Sutton Creek .004) and one site is on the

**Figure 6. *Botrychium pedunculatum* -- Stalked Moonwort**  
Occurrences on or near the Kootenai National Forest, Montana



Three Rivers District along Keeler Creek (003) south of Troy (Figure 6). Color photocopies of specimens from two populations on Big Creek were verified by W. H. Wagner (pers. commun.).

- b. HISTORICAL SITES: none
  - c. UNVERIFIED/UNDOCUMENTED REPORTS: Collections were not taken from Keeler Creek, Parsnip Creek, or Sutton Creek; I identified plants from these sites as the same taxon at the verified Big Creek sites based on unique coloration and stalked trophophores.
  - d. AREAS SURVEYED BUT SPECIES NOT FOUND: See Appendix A for a list of areas which I searched for moonworts.
- E. HABITAT
- 1. ASSOCIATED VEGETATION: Outside Montana *Botrychium pedunculosum* grows in meadows and openings. In the Willowa Mountains, Oregon where it is most abundant, it grows in abandoned oxbows with heavy cover by grasses and in openings in lodgepole pine (*Pinus contorta*) forests in close association with strawberries (*Fragaria virginiana*) (Zika 1994). In Washington it grows in moist meadows, swales, and roadsides (Washington Natural Heritage Program, pers. commun.).

In contrast to these sunny, early successional habitats, the sites on the KNF are old growth stands of western red cedar (*Thuja plicata*) in floodplain bottoms. Four of the sites are *Thuja plicata*/*Oplopanax horridum* habitat types, and one (Parship Creek) is a *Thuja plicata*/*Athyrium filix-femina* habitat type (Cooper et al. 1991). Canopy cover by cedar is very high while understory cover by shrubs, forbs, ferns and mosses is relatively low. Average age of the dominant tree class is 130 years or older, and some trees at each of the sites probably exceed 500 years in age. Although old growth cedar stands in floodplains are extremely stable, fire resistant climax types, persisting for 1,000 years or more, their understories are dynamic successional habitats prone to cycles of flooding and are influenced by upstream events.

Additional associated trees at one or more site on the KNF include *Picea* sp., *Populus balsamifera*, *Pseudotsuga menziesii*, and *Tsuga heterophylla*. Associated shrubs include *Acer glabrum*, *Oplopanax horridum*, and *Taxus brevifolia*. Forbs with high constancy include *Clintonia uniflora* and *Tiarella trifoliata*. Associated ferns, besides moonworts, include *Athyrium filix-femina*, *Botrychium virginianum*, *Gymnocarpium dryopteris*, and at Parship Creek, the sensitive species *Thelypteris phegopteris*.

At all known sites on the KNF, *Botrychium pedunculosum* occurs in genus communities with other moonworts. It is associated with *B. lanceolatum* at all five sites, and at one or more site it grows with *B. minganense*, *B. montanum*, or *B.*

*pinnatum*. Outside Montana, it also occurs with *B. lunaria* and *B. simplex* (Wagner and Wagner 1986).

Additional information on associated vegetation at individual KNF sites is provided by the general site description fields of the Element Occurrence Records in Appendix B, and Ecodata in Appendix C.

2. TOPOGRAPHY: On the KNF the sites are relatively low elevation floodplain bottoms of glaciated valleys. Elevations range from 2,600 to 3,200 feet. The microtopography is patterned or undulating caused by old stream channels, windthrow hummocks, and rotten logs. *Botrychium pedunculosum* grows in the bottoms of the depressions. The sites are adjacent to streams, have high water tables, and are prone to periodic flooding.
3. SOIL RELATIONSHIPS: The soils at all sites are formed in alluvial deposits. Landtype mapping units include 101 on alluvial floodplains and 103 on alluvial terraces (Kuennen and Nielsen-Gerhardt 1995). The Sutton Creek (004) and Parsnip Creek (002) sites are mapped as landtype 352 with soils formed in glacial till of mountain slopes, however, this is probably an artifact of mapping scale. At all sites on the KNF, *Botrychium pedunculosum* grows in soils formed in stratified alluvial deposits covered by shallow litter layers. In contrast to other KNF moonwort species of forested habitats, it has not been found growing in deep litter.
3. CLIMATE FACTORS: Moonworts in general are adapted to cool, moist climates. In Montana they are thus most common at low elevations in the northwest part of the state with its cool temperate, maritime influenced climate, while in semi-arid regions of the state (e.g. Granite, Deer Lodge, and Lewis and Clark counties) they are confined to higher elevations which receive heavy accumulations of snow. All known occurrences of *Botrychium pedunculosum* are at low elevations in the extreme northwest corner of the state. Climatic fluctuations may dramatically effect the phenology and numbers of moonwort sporophytes which produce above ground fronds in a growing season; in dry years fewer plants can be expected to be found and the length of the growing season is expected to be shorter. Because it grows in subirrigated habitats, *B. pedunculosum* is likely to be less affected by precipitation during the growing season, and more affected by total annual precipitation.

#### F. POPULATION DEMOGRAPHY AND BIOLOGY

1. PHENOLOGY: Fronds appear as early as late spring and die in early fall (Wagner and Wagner 1993). Phenology is greatly affected by moisture of the microsite, wetter habitats delay maturation and senescence (Zika 1994). In genus communities on the KNF *Botrychium pedunculosum* was observed to disperse spores later than *B. manganense* and earlier than *B. montanum*.

2. **POPULATION SIZE AND CONDITION:** The populations on the KNF are very small. The most plants found at one site was eight, and at two sites only one plant could be found. Numbers of *Botrychium pedunculatum* were fewer than other moonworts in the genus communities where they occur (Table 2, in results section). Areas of the populations are also small. At Big Creek and Keeler Creek, the plants are confined to small areas of remnant old-growth. Populations in Canada are also small (Zika 1994). Larger populations are known from Oregon (Wagner and Wagner 1986) and Washington (Washington Natural Heritage Program, pers. commun.). The plants found in Montana are shade forms (Wagner, pers. commun.) and most are relatively small with reduced spore producing capacity.
3. **REPRODUCTIVE BIOLOGY:** See the discussion of life history of moonworts following the introduction to this report.

#### G. POPULATION ECOLOGY

1. **COMPETITION:** The habitats of *Botrychium pedunculatum* on the KNF have dense tree canopies but sparse undergrowth, thus there is high competition for light but low levels of root zone competition. Low light may be a factor in the plants poor reproductive success on the KNF; larger populations are known from Oregon and Washington in sunny habitats. The occurrence of moonworts, including *Botrychium pedunculatum*, in genus communities seems to run counter to the competitive exclusion principle, however, plant densities are usually so low that competition between moonwort species is not expected. Furthermore, our observations suggest that the individual species have subtly different microhabitat preferences. For example, *B. pedunculatum* was found in moist depressions while *B. montanum* was on dryer hummocks at South Fork Big Creek (001).
2. **POSITIVE INTERACTIONS:** All *Botrychium* species are believed to be obligately dependent on mycorrhizal relationships in both the gametophyte and sporophyte generations. See the discussion of mycorrhizal relations following the Introduction of this report.
3. **HERBIVORY:** A nibbled plant was observed at South Fork Big Creek. Small animals may play a role in spore dissemination of moonworts (Zika 1992).

#### H. LAND OWNERSHIP: All known Montana occurrences are on the KNF, on the Rexford and Three Rivers Districts.

#### I. ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

1. **THREATS TO CURRENTLY KNOWN POPULATIONS:** All known Montana *Botrychium pedunculatum* populations are in floodplain bottoms and are potentially threatened by natural and human induced flooding events. The species is threatened

by floods more than other forest dwelling moonworts because its population numbers are extremely low and plants are confined to the bottoms of swales and channels in low elevation floodplains. In this respect it shares conservation concerns with the sensitive fern *Thelypteris phegopteris* (reviewed by Kuennen and Leavell 1993), with which it occurs at Parsnip Creek. Logging and road building is proposed in the upper drainage of Parsnip Creek (A. Deuker, pers. commun.) and these activities could result in increased stream flows which could potentially impact the populations of *B. pedunculatum* and *T. phegopteris* downstream. At South Fork Big Creek a culvert from a road above drains into the vicinity of the moonwort genus community and flooding in 1996 resulted in sedimentation in the area; no moonworts were found growing through the sediment but it is not known if the ferns previously grew in these areas. Flooding may also be caused by beaver dams.

1. MANAGEMENT PRACTICES AND RESPONSE: At Keeler Creek and Big Creek, the populations of *Botrychium pedunculatum* are confined to small groves of remnant old growth cedar in drainages which were heavily influenced by logging and catastrophic flooding in the last century. The extent to which flooding was caused by logging in these drainages is difficult to assess. Spruce logging occurred in the upper drainage of Keeler Creek prior to catastrophic flooding in the mid-1970's and is likely to have had some influence on the flood event (L. Kuennen, pers. commun.). Since then, "salvage" logging of large cedar in the bottom of Keeler Creek near the moonwort population has probably further depleted potential habitat. The concentration of known populations in the lower floodplains of creeks flowing into Lake Koocanusa suggests that the species may have been more extensive before Libby Dam was built.
3. MANAGEMENT SUMMARY: *Botrychium pedunculatum* was found in Montana for the first time in 1996. The species does not currently have official Region 1 sensitive status but listing is now proposed and in the interim it should be treated as sensitive. The species is one of the rarest moonworts both in Montana and throughout its range and is "of conservation concern" (Wagner and Wagner 1993). The species has been added to the state list of plant species of special concern maintained by MTNHP and accorded the rank of S1. All known populations of this species should be given high conservation priority and additional survey for the species should be conducted not only within proposed project boundaries but also in floodplains downstream.

*Botrychium pedunculatum* is probably adapted to a shifting mosaic of understory habitats created by scouring and deposition by flood events followed by accumulation of organic matter and recolonization by plants. However, the areal extent where these natural cycles can occur and intervals between these events have been reduced by management activities such as logging, and road and dam building. It is highly likely that potential habitat for *B. pedunculatum* has been greatly reduced in recent decades.

## RECOMMENDATIONS AND CONCLUSION

**Status recommendations:** Current and recommended Montana Natural Heritage Program state ranks and USFS status of the six moonwort species treated in detail in this report are summarized in Table 6. The species were scored using the most updated information according to USFS Region 1 sensitive plant scoring criteria (Appendix H) and the total score for each is included in Table 6. In the past, species with a total of 15 or more have been nominated for designation as sensitive by the Regional Forester (S.Shelly, pers. commun.). The process of designating sensitive species is currently being evaluated nationally with efforts being made to standardize criteria, so changes are possible within Region 1.

Table 6. Current and recommended Montana Natural Heritage Program state ranks and USFS status of *Botrychium* species on the Kootenai National Forest.

	State rank		USFS status		
	current	recommended	current	score	recommended
<i>B. ascendens</i>	S1	S1	sensitive	20	sensitive
<i>B. crenulatum</i>	S2	S2	sensitive	17	sensitive
<i>B. minganense</i>	S2S3	S3	ensitive	11	sensitive
<i>B. montanum</i>	S2	S2	sensitive	20	sensitive
<i>B. paradoxum</i>	S1	S1	sensitive	15	sensitive
<i>B. pedunculosum</i>	none	S1	none	22	sensitive

The discovery of the first known Montana occurrences of *Botrychium pedunculosum* in 1996 makes its inclusion as a Montana Plant Species of Special Concern appropriate at this time. This species received the highest sensitive plant criteria score due to its extreme global rarity, local habitat specificity, and apparent historical loss of habitat in Montana and is recommended for designation as sensitive in USFS Region 1. It is appropriate to address species deemed of conservation concern, but not yet officially designated sensitive, in NEPA documents apart from the Biological Evaluation process (S. Shelly, pers. commun.).

Documentation of many new populations of *Botrychium minganense* on the KNF in 1995 required that the Montana Natural Heritage Program state rank be changed from S1 to S2S3. Documentation of several more in 1996 makes S3 now appropriate. At this point most taxa are dropped from tracking by MTNHP. It now appears that this species is probably the most common moonwort on the KNF and in Montana. Based on these updates it received a sensitive species criteria score of 11, below the past threshold for designation as sensitive by USFS Region 1. However, I recommend that sensitive status be retained for the species and



it continue to be tracked by MTNHP at this time because 1) sites with *B. minganense* may host other more rare *Botrychium* species which may be overlooked by initial surveys, 2) misidentification is common, and 3) taxonomic revisions involving this species group are in progress (K. Ahlenslager, W. Wagner pers. commun.).

Current state ranks and Forest Service sensitive status remain appropriate for the other four species treated in this report. Although a relatively large number of new occurrences of *B. montanum* were also documented on the KNF, this species already had a state rank of S2, a rank which was probably too high based on the few occurrences previously known in the state. Its habitat specificity and occurrence in proposed cutting units are also reason for retaining S2 status. The state rank of *B. crenulatum* was changed from S1 to S2 in 1996 based on the new populations found on the KNF in 1995.

**Threats to populations:** Occurrences of sensitive moonworts on the KNF are potentially threatened by natural events and by direct and indirect effects of management activities. Natural processes which may impact populations include flooding due to climate or beaver dams, succession, wildfire, herbivory, and drought. Upland sites are most threatened by the direct effects of logging since they are often included in management areas designated suitable for timber harvest (U.S Forest Service 1987). Many of the occurrences of *Botrychium minganense* and *B. montanum* found by KNF personnel are in proposed cutting units. Canopy removal and disturbance of surface substrates by machinery or prescribed burning is likely to eliminate moonworts from a site for a relatively long period. Lowland floodplain sites are especially threatened by indirect and cumulative effects of logging and road building in the drainages upstream. Two of the rarest species, *B. ascendens*, and *B. pedunculatum*, as well as the few known occurrences of *B. crenulatum* in natural settings, are especially susceptible to road washouts, sedimentation, and stream rechanneling caused by increased runoff within their drainages. Mining is less extensive than logging on the KNF but a proposed mine at Rock Creek may effect a population of moonworts on ASARCO land. Roadside sites of *Botrychium crenulatum* are threatened by log decking, road maintenance, parking, cattle trampling and herbicide use. The effects of grazing on populations of moonworts is not known. It is suspected that light levels of grazing would not adversely affect populations, while heavy levels would. This potential threat is mostly confined to the roadside and meadow habitats of *B. crenulatum* and *B. minganense* on the Fortine and Rexford Districts. Collection of specimens by botanists may significantly impact small populations of the rarest species.

**Interim management guidelines:** The goal of conservation management for sensitive moonworts on the KNF is to maintain viable populations and numbers of all species across their current geographical and ecological range on the Forest into the foreseeable future. To accomplish this goal an integrated program of project assessment and amendment, population protection and preserve designation is recommended. These recommendations are meant to be interim guidelines, are subject to U.S. Forest Service review, and should be amended as new information becomes available.

1. Clearance surveys should pay special attention to identifying and surveying microfeatures such as draws, seeps, benches, and moist flat areas within project boundaries and in floodplains downstream from proposed projects. The vegetation types listed in the results section of this report for each sensitive *Botrychium* species may be used to identify primary potential habitat, but other moist habitat types should also be considered as potentially hosting moonworts.
2. Results of clearance surveys should be assessed in the context of the year's climate, available personnel hours, and the relative ease or difficulty of survey in particular habitats. Populations of moonworts are likely to go undetected or underestimated in dry years, requiring greater reliance on probability analysis and repeated surveys. Habitats with depauperate understories (most seral stages of cedar and hemlock forest types) require less time and survey intensity than habitats with heavy understory cover (some open old growth stands, riparian thickets, meadows).
3. The presence of one moonwort species at a site increases the probability of other species occurring nearby. Over half the known sensitive *Botrychium* occurrences on the KNF are in moonwort genus communities. This phenomenon is a key to identifying and protecting potential habitat for the rarest species.
4. Before any occurrence of a sensitive *Botrychium* species is impacted by a management activity, a complete survey should be conducted of the entire potential habitat to assess the magnitude of the population and species diversity of the community. Repeat surveys will often be needed to accomplish this due to the unique phenological and dormancy attributes of the different species. Collection of specimens and consultation may be required for reliable species identification. In some cases it will be more opportune to protect the population and potential habitat by modifying project plans, rather than postponing actions until a complete survey can be accomplished.
5. Protect all known KNF populations of the rarest *Botrychium* species, *B. ascendens*, *B. paradoxum*, and *B. pedunculosum* from direct, indirect, and cumulative effects of management activities and foreseeable natural threats. *Botrychium ascendens* and *B. pedunculosum* are known only from lowland floodplain habitats and are especially threatened by indirect and cumulative effects of logging and road building upstream in their drainages. Conservation management at the drainage level is required for these species.
6. Accord similar protection for significant verified populations of *Botrychium crenulatum* in unaltered native habitat (Beaver Creek .007, Chief Creek .009, Alexander Mountain .005). These sites are also floodplains subject to indirect and cumulative effects within their drainages.
7. Amend project plans as necessary to maintain viable populations and current geographic range of all sensitive *Botrychium* species on the KNF. Some individuals,

subpopulations, or small populations of the more common species (*B. crenulatum*?, *B. minganense*, *B. montanum*) may be sacrificed if metapopulation structure and/or geographic distribution of the species on the district is maintained. The significance of each occurrence should be determined on a case by case basis. Maintain the integrity of all "core" populations, those with high numbers and high quality habitat, and all peripheral and outlying populations which are important to the geographic distribution of the species on the KNF. Examples of these types are listed in Table 7, however, these lists may not be inclusive and should be amended as new information becomes available.

Table 7. "Significant" populations of the more common sensitive *Botrychium* species on the Kootenai National Forest. Note: all populations of the rarest species *B. ascendens*, *B. paradoxum*, and *B. pedunculatum* are significant.

peripheral and outlying occurrences		"core" populations	
<i>B. crenulatum</i>		<i>B. crenulatum</i>	
Basin Creek (004)	D4	Beaver Creek (003)	D3
Chief Creek (009)	D5	Alexander Mountain (005)	D5
Rock Creek (002)	D7	Chief Creek (009)	D5
<i>B. minganense</i>		<i>B. minganense</i>	
Grave Creek Campground (047)	D3	S. F. Big Creek (046)	D1
Othorp-Morgan Lake (066)	D3	Sutton Creek (049)	D1
Sterling Creek	D3	Bunker Hill Creek (017)	D4
Ross Creek Cedars (010)	D4	French Creek (021)	D4
Poorman Creek (050)	D5	Kelsey Creek (025)	D4
Bull River (047)	D7	Red Top Creek (038)	D4
		Zulu Creek (028)	D4
<i>B. montanum</i>		Fawn Creek (020)	D5
Sutton Creek (024)	D1	West Pipe Creek (013)	D5
Sterling Creek (028)	D3		
Keeler Creek (026)	D4	<i>B. montanum</i>	
Cedar Creek (014)	D5	Sutton Creek (024)	D1
Houghton Creek (026)	D5	Sterling Creek (028)	D3
Berray Mountain (017)	D7	Beetle Creek (031)	D4
		Can Creek (009,011)	D4
		French Creek (020)	D4
		Kelsey Creek (012)	D4
		Red Top Creek (022)	D4
		Roderick Butte (018)	
		D4	
		West Pipe Creek (013)	D5

8. Project modifications to protect moonwort occurrences should be designed to maintain current light levels and hydrological regimes and leave the surface substrate undisturbed in the population area. Buffer zones should be adequate to compensate for blowdown. Machinery should be kept out of the population area and potential habitat and the area should be protected from controlled burns.
9. Established riparian timber harvest guidelines for the KNF (U.S. Forest Service 1994b) do not provide adequate protection for populations of sensitive moonworts. These allow reduction of canopy cover along perennial streams, larger ephemeral streams, and around wetlands, complete canopy removal in dry draws and swales, and slash burning in all types of riparian zones. The effects of these activities are likely to impact moonwort populations by increasing root zone competition, reducing litter accumulations, and affecting microclimate and hydrology.
10. Monitor populations likely to be impacted by project activities before and after the commencement of the activity to accumulate evidence for assessing impacts of future projects. Lesica and Steele (1994) discuss special monitoring requirements and analysis for species, such as moonworts, which undergo prolonged dormancy. Continue yearly monitoring of *Botrychium minganense* and *B. montanum* at French Creek (Appendix D) to establish baseline demographic parameters for these two species.
11. Continue to pursue resolution of outstanding taxonomic questions. Collect specimens as needed to accomplish this goal in accordance with the guidelines in Appendix E. Take advantage of wet years for resurveying and collecting from populations with unresolved questions. Occurrences with questions concerning identification are listed in the unverified/undocumented reports section of the status reviews in this report.
12. Begin to pursue designation of preserves (botanical special interest areas and research natural areas) for the most significant and defensible populations and genus communities. Base preserve selection on species composition, population numbers and areal extent, habitat quality and stability, geographic representation of the occurrence, and adequacy of protection offered by current management area designation.

**Conclusion:** Great progress has been made in knowledge of moonwort habitat and distribution in Montana, especially on the KNF, providing the framework for expanding our understanding of the ecology, genetics, and conservation requirements of these unique plants. Pertinent research is underway or proposed at at least four universities. Research on moonwort/fungal mycorrhizal relations is being conducted at the University of Oregon by a graduate student, Francisco Comacho. Research on genetic markers of one of the most confusing pair of species, *Botrychium crenulatum* and *B. minganense*, including material from the KNF, is being conducted by a graduate student, Linda Swartz, at the University of Idaho. A professor at Iowa State University, Donald Farrar, who has developed protocol for studying isozymes of

moonworts, has been contracted to investigate genetics of moonwort species on the Colville National Forest in Washington (K. Ahlenslager, pers. commun.). At the University of Montana, Roger Ferreil has undertaken graduate research to further characterize the habitats of sensitive moonworts on the KNF, and to develop a management strategy for their conservation on the Forest.

A hypothesis to explain the occurrence of large genus communities can be made based on spatial and temporal considerations. Current species concepts of *Botrychium* subgenus *Botrychium* would indicate that genus communities are the result of multiple introduction events, potentially of a single spore of each species, to a mutually suitable habitat. The probability of more than one species colonizing a site is likely to increase with the size of habitat, heterogeneity of microhabitats, and time. Time is also a necessary element for population expansion. The occurrence of large numbers of several moonwort species at a site may indicate ancient habitat. This theory is supported by the preponderance of large genus communities in relatively old stands of western red cedar. Old growth also has structural complexity, of both canopy and microtopography, which may allow several moonwort species with similar but slightly different habitat preferences to coexist. This hypothesis may be tested by analyzing Ecodata to distinguish the habitats of large populations and genus communities from those of small occurrences of single species, which may be incidental and ephemeral, or alternately, may have potential for development into larger populations or genus communities.

Expansion of the guidelines recommended on pp. 72-74 in this report into a conservation strategy for the KNF should integrate the results of all new research and set the stage for long term conservation and monitoring of these species. Perhaps the greatest research contributions which can be made are 1) expansion and refinement of Ecodata habitat characterization to include all types and to define "ideal" habitat for genus communities and for each of the sensitive species and 2) determination of landscape processes necessary for perpetuating these habitats across the Forest. Starting with this information, a conservation strategy should establish guidelines for assessing cumulative effects of management activities in drainages where sensitive moonwort populations occur in lowland floodplains. Drainages where catastrophic flooding has apparently impacted occurrences of moonworts (e.g. Keeler Creek, West Fisher Creek) should be analyzed to determine if there are cause and effect relationships between the flood events and past management activities. Historical aerial photographs and stand records, on-site inspections, and GIS mapping techniques may be useful for this purpose. The results of these analyses should then be applied to drainages where management activities are proposed upstream from floodplain occurrences of sensitive moonworts (e.g. Parsnip Creek).

Although genus communities are an indication of overlapping habitat preferences of moonwort species, there are also notable differences between species which need to be considered in developing conservation strategies. There is a growing accumulation of evidence that supports the modern taxonomic treatment (splitting) of *Botrychium* subgenus *Botrychium* (sensu Wagner and Wagner 1993). Besides the morphological and cytological characters emphasized by the

Wagners, there are differences between species in genetics (Hauk 1995), developmental parameters (Campbell 1922), demographic profiles (Ahrensleger and Lesica 1995, Lesica and Ahrensleger 1996), possibly mycorrhizal relationships (Comacho 1996, Campbell 1922), and, as shown by the results of this conservation assessment, in phenology, geographic distribution, and micro- and macro-habitat preferences. The most significant variation in habitat on the KNF is between the "east side" deciduous thicket habitats of *Botrychium ascendens* and *B. crenulatum* and the "west side" old growth forest habitats most typical of *B. minganense* and *B. montanum*. Preferences of *B. ascendens*, *B. paradoxum*, and *B. pedunculatum* for habitats which are scarce on the KNF may help explain their rarity on the Forest.

In the last few years the Kootenai National Forest has emerged as the "moonwort capital of Montana." About 70% of the known occurrences of sensitive *Botrychium* species in the state are from the KNF and most of these have been documented in the last two years. This high percentage is partly due to the level of funding for botany work on the Forest, and is an indication of the need for further survey work elsewhere in the state. However, it is clear that the KNF is a stronghold for moonworts, especially for *B. minganense*, *B. montanum*, and *B. crenulatum*. The relative abundance of these species stems from the prevalent biogeoclimatic parameters of the Forest. The KNF has the largest area in the state of low elevation glaciated topography with maritime influenced climate. Growing seasons are long and cool, with high precipitation and humidity. There are recurring examples of old growth stands of western red cedar and western hemlock which are the favored habitats of *B. minganense*, *B. montanum*, and moonwort genus communities. There are extensive areas with alluvium derived from calcareous glacial till, the substrate preferred, if not required, by *B. crenulatum*. In addition to hosting many significant core populations of these three species, the KNF has all occurrences of *B. pedunculatum* and three of the four occurrences of *B. ascendens* known in the state; these two species are among the most globally rare of the subgenus. Conservation of sensitive moonworts on the KNF is a keystone for their state and global conservation.

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CONSERVATION ASSESSMENT OF SENSITIVE MOONWORTS  
(OPHIOGLOSSACEAE; *BOTRYCHIUM* SUBGENUS *BOTRYCHIUM*)  
ON THE KOOTENAI NATIONAL FOREST

Jim Vanderhorst, 1997.

APPENDIX A: AREAS AND HABITATS SEARCHED

APPENDIX B: ELEMENT OCCURRENCE RECORDS AND MAPS

APPENDIX C: ECODATA

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APPENDIX F: ASSOCIATED FUNGI

APPENDIX G: ASSOCIATED MOSSES

APPENDIX H: SENSITIVE PLANT SCORING CRITERIA

APPENDIX I: PHOTOGRAPHIC SLIDES

## APPENDIX A: AREAS AND HABITATS SEARCHED

The following locations and habitats were searched intensively for moonworts by Jim Vanderhorst, sometimes accompanied by others (M. Arvidson, T. Bielak, L. Ferguson, J. Reny, L. Sedler) in 1995 and 1996. Each discrete habitat at a location is briefly described separated by commas, and if *Botrychium* species (including non-sensitive species as field notes allow) were found they are noted in parentheses following the description. All locations and habitats which were searched but where no *Botrychium* species were found are also included.

1995:

### REXFORD DISTRICT (D1)

Big Creek (T35N R29W S31W N1/2): large second growth cedar and cottonwoods.

Big Creek (T34N R30W S5 NE1/4): seepy valley bottom with cedar/devils club (I didn't find any but *B. minganense* was later found by Rexford personnel just downstream).

Big Creek (T34N R30W S16): second growth cedar/devils club with mixed conifers.

Dodge Creek (T37N R29W S26 SE1/4): (*B. minganense* collected from section in 1971 but not found in 1995), small stream with sedges, surrounding logged spruce habitat with strawberries.

### FORTINE DISTRICT (D3)

Beaver Creek (T33N R26W S8, S9, S16, S21): brushy opening in spruce (*B. ascendens*, *B. crenulatum*) spruce forest, sedge dominated wetlands, clearcuts in stream bottom with strawberries, streamside deciduous thickets.

Swamp Creek (T33N R27W S34 SE1/4): spring edges in clearcut, rocky draw with spruce windfall.

Swamp Creek (T33N R27W S26 N1/2): aspen stands with blowdown (*B. crenulatum*, *B. minganense*), grazed clearcuts and wetlands.

Wigwam River (T37N R25W S10 NE1/4, S11 NW1/4, S16 SE1/4): young reprod w/ strawberries, wetter logged spruce habitat, wetlands.

### THREE RIVERS DISTRICT (D4)

Basin Creek (T36N R30W S4): roadside swale with wet site forbs (*B. crenulatum*) roadside cutbank with rodent diggings (*B. lunaria*), roadside with heavy smooth brome cover, second growth cedar/horsetail habitat with fire evidence, clearcut with young reprod and strawberries.

- Basin Creek (T36N R30W S16): second growth cedar (*B. manganense* in cedar habitat further upstream, seral stage?).
- Beetle Creek tributary (T36N R33W S24 NW1/4): swales under devils club in remnant stand of old growth cedar missed by fires (*B. manganense*), across the creek in openings which were burned, alder thickets.
- Can Creek (T35N R31W S32 S1/2, S33 S1/2): swales, seepy draws, and stream bottoms with cedar habitat types (*B. lanceolatum*, *B. manganense*, *B. montanum*; *B. paradoxum* found by L. Ferguson in 1993, but could not be relocated on three attempts in 1995), skid trail around unit with young reprod (*B. multifidum*) second growth cedar with stumps in valley bottom.
- Clay Mountain (T34N R31W S6 NW1/4): concave bench with hemlock h. t. with heavy cedar canopy and litter layer (*B. montanum*), level swale in burned clearcut with increased cover by forbs, wood, and bare soil.
- Door Skeels (T29W R33W S20): floodplain cedar/devils club habitat (*B. manganense* reported by T. Desy but I could not find).
- Forest Creek (T35N R34W S27 SE1/4): draw with high gradient stream and feeder streamlets in old growth cedar/devils club habitat (*B. manganense*) opposite aspect where menziesia replaces devils club.
- French Creek (T37N R32W S34): swales and seeps in cedar habitat (*B. manganense*, *B. montanum*), slopes and rocky areas in cedar habitat.
- Garver Creek (T37N R32W S18 NE1/4): subalpine fir/spruce forest, streamside deciduous thickets.
- Kelsey Creek (T35N R31W S29 S1/2): maturing cedar with heavy litter (*B. manganense*, *B. montanum*), deciduous thicket opening (*B. virginianum* but no moonworts).
- Little Creek (T35N R33W S27 SW1/4, S28 SE1/4, S 34 NW1/4): slopes and seep with heavy cedar canopy (*B. manganense*), slopes and seeps in alder brushfields (old logging unit or burn?).
- Pete Creek (T36N R33W S13): old growth cedar and hemlock along low gradient tributary in valley bottom (*B. lanceolatum*, *B. manganense*).
- Pete Creek drainage (T36N R33W S11 SW1/4): slopes with mixed conifer forest with some cedar, rocky mossy openings, young hemlock with burned snags, cedar/devils club habitat.

Pete Creek Meadows (T37N R33W S24 NW1/4): graminoid dominated meadows (*B. multifidum*), alder and willow thickets, openings with burned snags, pole size spruce stands.

Red Top Creek (T34N R34W S2 SW1/4): swales, seeps, and benches in standing old growth cedar habitat (*B. lanceolatum*, *B. manganense*, *B. montanum*, *B. pinnatum*), swales, seeps, and benches in 5 yr. old clearcut in same habitat type.

Roderick Butte (T35N R32W S26 NW1/4, S23 SW 1/4): maturing cedar in low gradient draw bottom (*B. montanum*), edges of fen.

Ross Creek (T28N R34W S12): along floodplain channels in ancient cedar grove (*B. manganense*), elsewhere in same grove, streamside openings with heavy fern and forb cover, beaver pond wetlands.

South Meadow Creek (T35N R34W S21 NE1/4, S22 NW1/4): old growth cedar/devils club habitat in valley bottom (*B. manganense* found in 1993, could not be relocated in 1995), bottom of adjacent clearcut with swales, high gradient streamside with cedar and hemlock, high gradient streamside in clearcut.

Zulu Creek (T34N R31W S4 SE1/4): Old growth cedar remnants along low gradient tributary (*B. manganense*), surrounding second growth burned in early 1900's.

Zulu Creek (T34N R31W S10 SW1/4): old growth cedar with blowdown in stream bottom and around seep (*B. manganense*, *B. montanum*, *B. paradoxum*, *B. pinnatum*, *B. virginianum*)

#### LIBBY DISTRICT (D5)

Alexander Creek (T31N R29W S30 W1/2, S31): low gradient stream bottom with alder thicket (*B. crenulatum*), surrounding old growth cedar, high gradient stream bottom with shrubs, second growth cedar.

Bigfoot Creek (T35N R32W S34 NW1/4): high gradient streamside with old growth cedar/devils club.

Chief Creek (T28N R28W S23 NE1/4, S24 SE1/4): hummocky wetland edge at outlet with blowdown and shrubs (*B. crenulatum*), rhizomatous sedge dominated wetland, spruce forest, other wetland edges.

Cow Creek (T28N R28W S11): stream corridor with cedar and oak fern.

Hemlock Creek (T33N R32W S10 SW1/4, S16 NE1/4, S15 NW1/4): along rivulet in old growth cedar/devils club missed by fires (*B. manganense*), stream corridor with burned snags, deciduous thickets.



Pipe Creek (T33N R31W S34 NW1/4): on old skid trail where it crosses draw bottom and in deciduous thicket opening in medium sized cedar (*B. montanum*)

Purcell Ridge (T34N R31W S26 SW1/4): draw with mixed conifers and huckleberry (1 plant *B. minganense*).

Quartz Creek (T32N R32W S35 N1/2, S14, S3): old growth cedar/devils club habitat., floodplain openings with heavy shrub, forb, and fern cover.

West Pipe tributary (T32N R31W S8 E1/2): in duff and along mossy seep in stand of pole to medium sized cedar (*B. montanum*), old growth cedar and devils club/alder opening (*B. minganense*, *B. montanum*).

#### CABINET DISTRICT (D7)

Berray Cedars (T28N R33W S25 SW1/4): flats and swales in ancient cedar grove (*B. montanum*), steeper draw bottom in ancient cedars.

Big Cedar Gulch/Rock Creek (T26N R32W S15 SE1/4): dry draw with second growth cedar/hemlock, stream bars with huge cedar stumps and evidence of large scale hydrological disturbance.

East Fork Rock Creek (T26N R32W S2): second growth cedar/devils club with moist mossy swales.

East Fork Bull River (T27N R32W S5 SE1/4, S11 NW1/4): second growth cedar/hemlock in floodplain bottom with channels, old growth cedar islands, old growth cedar stream bottom.

Rock Creek Meadows (T26N R31W S6 N1/2): grass and sedge dominated meadows and spruce forest edges.

1996

#### REXFORD DISTRICT (D1)

Big Creek (T35N R30W S35 NW 1/4): remnant old growth *Thuja plicata*/*Oplopanax horridum* (*B. lanceolatum*, *B. minganense*, *B. pedunculatum*), second growth

Sutton Creek (T35N R28W S33 NW 1/4): floodplain with *Thuja plicata*/*Oplopanax horridum* (*B. lanceolatum*, *B. minganense*, *B. montanum*, *B. pinnatum*, *B. pedunculatum*)

South Fork Big Creek (T34N R30W S4 NE 1/4, T35N R30W S35 NW 1/4): floodplain with *Thuja plicata*/*Oplopanax horridum* (*B. lanceolatum*, *B. minganense*, *B. montanum*, *B. pedunculatum*), terrace with mixed seral conifers and heavy forb cover

Water Trough Draw (T35N R28W S13): old roadway (*B. crenulatum*), mossy area along ephemeral stream with *Picea* (*B. crenulatum*)

#### FORTINE DISTRICT (D3)

Morgan Lake (T36N R27W S33 NE 1/4): heavily grazed *Agoseris stolonifera* disclimax in old cleared area around alkaline pothole (*B. minganense*, discovered by T. Spribille), similar habitat in area

Lost Lake (T35N R27W S1 E 1/2): hummocky *Agoseris stolonifera* grazing disclimax

Turtle Lake (T36N R27W S34 NE 1/4): lakeside *Agoseris stolonifera* grazing disclimax, heavily grazed and within exclosure

#### THREE RIVERS DISTRICT (D4)

Arbo Creek (T33N R33W S14 NW 1/4): rocky floodplain with *Thuja plicata*/*Oplopanax horridum* h.t. selectively logged in past (*B. minganense*, *B. montanum*)

Beetle Creek (T36N R33W S3 SE 1/4, S10 NE 1/4): old growth *Tsuga heterophylla*/*Clintonia uniflora*

Bunker Hill Creek (T36N R31W S10 NW 1/4): old growth *Thuja plicata*/*Oplopanax horridum* (*B. minganense* previously known and relocated)

Door Skeels (T29W R33W S20): floodplain with *Thuja plicata*/*Oplopanax horridum* (*B. minganense* reported by T. Desy but I could not find in 1995 or 1996).

Keeler Creek (T30N R34W S28 NW 1/4, S29 NE 1/4, S27): old floodplain (now elevated by creek washouts) with old growth *Thuja plicata*/*Oplopanax horridum* (*B. lanceolatum*, *B. montanum*, *B. pedunculatum*), second growth mixed conifers with old skidtrails

Spar Springs area (T29N R34W S13): logged *Thuja plicata*/*Oplopanax horridum* habitat type, swampy areas with heavy cover by *Athyrium filix-femina*

Seventeen Mile Creek (T33N R32N S5 northern edge): floodplain with old growth *Thuja plicata*.

South Fork Meadow Creek (T35N R34W S21 E 1/2): old growth *Thuja plicata*/*Oplopanax horridum* (relocated previously known *B. minganense*)

Spread Creek (T36N R33W S33 SW 1/4, S32 SE 1/4): second growth *Tsuga heterophylla*, old growth *Tsuga heterophylla* with heavy moss cover, old growth and burned (1910's) *Thuja plicata*/*Oplopanax horridum* (*B. montanum*)

Whitetail Creek (T36N R33W S25 NW 1/4): draw with *Thuja plicata*/*Clintonia uniflora* (*B. minganense*).

#### LIBBY DISTRICT (D5)

Bristow Creek (T32N R29W S15 NE 1/4): high gradient calcareous stream channel (*B. crenulatum* found by J. Reny in 1995, but I could not find, habitat is unusual)

Poorman Creek (T28N R31W S25 S 1/2, S35 N 1/2): *Tsuga heterophylla*/*Clintonia uniflora* h.t., pole sized *Thuja plicata* on edge of wetland (*B. lanceolatum*), *Thuja plicata*/*Oplopanax horridum* h.t. (*B. minganense*)

Warland Creek (T32N R28W S35 NE 1/4): open stand of mixed conifers with brushy stream bottom (*B. minganense* found by J. Reny and T. Bielak in previous year but I could not relocate).

West Pipe tributary (T32N R31W S8 E 1/2, S9 W 1/2): *Thuja plicata*/*Oplopanax horridum* (*B. minganense*, *B. montanum*), *Thuja plicata*/*Athyrium filix-femina* (*B. minganense*), old roadbed with *Alnus*

#### CABINET DISTRICT (D7)

Big Eddy (T27N R34W S25 SW 1/4): seep with pole-sized *Thuja plicata*

Middle Fork Bull River (T28N R33W S11 SE 1/4, S12 SW 1/4, S14 N 1/2): *Thuja plicata*/*Oplopanax horridum*, *Thuja plicata*/*Clintonia uniflora*.

North Fork Bull River (T28N R33W S11 SE 1/4): seral *Thuja plicata*/*Oplopanax horridum* with heavy cover by pole sized *Abies grandis* (*B. minganense*).

# APPENDIX B: ELEMENT OCCURRENCE RECORDS AND TOPOGRAPHIC MAPS

## INDEX TO SENSITIVE MOONWORT EOR'S ON THE KNF BY DISTRICT

### Rexford District (D1)

<i>Botrychium crenulatum</i>	
Sutton Creek	.003
Water Trough Draw	.012

<i>B. minganense</i>	
Big Creek	.060
North Fork Dodge Creek	.041
Parsnip Creek	.059
South Fork Big Creek	.046
Sutton Creek	.049

<i>Botrychium montanum</i>	
Parsnip Creek	.030
South Fork Big Creek	.029
Sutton Creek	.024

<i>Botrychium pedunculatum</i>	
Big Creek	.005
Parsnip Creek	.002
South Fork Big Creek	.001
Sutton Creek	.004

### Fortine District (D3)

<i>Botrychium ascendens</i>	
Beaver Creek	.003

<i>Botrychium crenulatum</i>	
Beaver Creek	.007
Bluebird Lake	.015
Green Mountain	.016
Lime Creek	.017
Stewart Creek	.019
Sunday Creek	.018
Swamp Creek	.008
Wolverine Creek	.013

### Fortine District (D3) continued

<i>Botrychium minganense</i>	
Grave Creek Campground	.043
Othorp-Morgan Lake	.066
Sterling Creek	.067
Swamp Creek	.045

<i>Botrychium montanum</i>	
Sterling Creek	.028

### Three Rivers District (D4)

<i>Botrychium crenulatum</i>	
Basin Creek	.004

<i>Botrychium minganense</i>	
Arbo Creek	.065
Basin Creek	.016
Basin Creek	.051
Basin Creek	.057
Beetle Creek	.033
Bunker Hill Creek	.017
Can Creek	.044
Can Creek Drainage	.018
Upper Can Creek	.030
Forest Creek	.040
Fowler Creek	.039
French Creek	.021
Hemlock Creek	.037
Kelsey Creek	.025
Little Creek	.019
North Fork Meadow Creek	.064
South Fork Meadow Creek	.014
Pete Creek	.032
Red Top Creek	.038
Ross Creek Cedar Grove	.010
Spread Creek	.015
Turner Creek	.056
Upper Turner Creek	.063
Whitetail Creek	.052

**Three Rivers District (D4) continued***Botrychium minganense* continued

Upper Whitetail Creek	.048
Zulu Creek	.028
Zulu Creek Pack Trail	.031

*Botrychium montanum*

Arbo Creek	.034
Beetle Creek	.031
Can Creek	.011
Upper Can Creek	.009
Clay Mountain	.019
French Creek	.020
Kelsey Creek	.012
Keeler Creek	.027
Mount Baldy	.025
North Fork Meadow Creek	.033
Red Top Creek	.022
Roderick Butte	.018
Turner Creek	.032
Zulu Creek	.015

*Botrychium paradoxum*

Can Creek	.009
Can Creek Drainage	.008
Zulu Creek	.010

*Botrychium pedunculatum*

Keeler Creek	.003
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**Libby District (D5)***Botrychium ascendens*

Houghton Creek	.004
West Fisher Creek	.002

*Botrychium crenulatum*

Alexander Mountain	.005
Alexander Creek	.010
Bristow Creek	.011
Chief Creek	.009

*Botrychium minganense*

Brush Creek	.042	
Cedar Creek	.027	
Doak Creek	.053	
East Fork Pipe Creek	.036	
Fawn Creek	.020	
Houghton Creek	.022	
Pipe Creek	.026	
Pipe Creek	.058	
Poorman Creek	.050	
Purcell Ridge	.029	
Swamp Creek	.045	
Warland Creek	.035	
West Fisher Creek	.034	
Weigel Creek		.054
Upper Weigel Creek	.061	
Weigel Mountain	.055	

*Botrychium montanum*

Cedar Creek	.014
Everett Creek	.021
Houghton Creek	.026
Pipe Creek	.016
West Pipe Creek	.013

**Cabinet District (D7)***Botrychium crenulatum*

Rock Creek	.002
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*Botrychium minganense*

Bull River	.047
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*Botrychium montanum*

Berray Mountain Cedars	.017
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## INDEX TO SENSITIVE MOONWORT EOR'S ON THE KNF BY SPECIES

### *Botrychium ascendens*

- 002 West Fisher Creek
- 003 Beaver Creek
- 004 Houghton Creek

### *Botrychium crenulatum*

- 002 Rock Creek
- 003 Sutton Creek
- 004 Basin Creek
- 005 Alexander Mountain
- 007 Beaver Creek
- 008 Swamp Creek
- 009 Chief Creek
- 010 Alexander Creek
- 011 Bristow Creek
- 012 Water Trough Draw
- 013 Wolverine Creek
- 015 Bluebird Lake
- 016 Green Mountain
- 017 Lime Creek
- 018 Sunday Creek
- 019 Stewart Creek

### *Botrychium minganense*

- 010 Ross Creek Cedar Grove
- 014 South Fork Meadow Creek
- 015 Spread Creek
- 016 Basin Creek
- 017 Bunker Hill Creek
- 018 Can Creek Drainage
- 019 Little Creek
- 020 Fawn Creek
- 021 French Creek
- 022 Houghton Creek
- 025 Kelsey Creek
- 026 Pipe Creek
- 027 Cedar Creek
- 028 Zulu Creek
- 029 Purcell Ridge
- 030 Upper Can Creek
- 031 Zulu Creek Pack Trail
- 032 Pete Creek
- 033 Beetle Creek
- 034 West Fisher Creek

### *Botrychium minganense continued*

- 035 Warland Creek
- 036 East Fork Pipe Creek
- 037 Hemlock Creek
- 038 Red Top Creek
- 039 Fowler Creek
- 040 Forest Creek
- 041 North Fork Dodge Creek
- 042 Brush Creek
- 043 Grave Creek Campground
- 044 Can Creek
- 045 Swamp Creek
- 046 South Fork Big Creek
- 047 Bull River
- 048 Upper Whitetail Creek
- 049 Sutton Creek
- 051 Basin Creek
- 050 Poorman Creek
- 053 Doak Creek
- 052 Whitetail Creek
- 054 Weigel Creek
- 055 Weigel Mountain
- 056 Turner Creek
- 057 Basin Creek
- 058 Pipe Creek
- 059 Parsnip Creek
- 060 Big Creek
- 061 Upper Weigel Creek
- 063 Upper Turner Creek
- 064 North Fork Meadow Creek
- 065 Arbo Creek
- 066 Othorp-Morgan Lake
- 067 Sterling Creek

### *Botrychium montanum*

- 009 Upper Can Creek
- 011 Can Creek
- 012 Kelsey Creek
- 013 West Pipe Creek
- 014 Cedar Creek
- 015 Zulu Creek
- 016 Pipe Creek
- 017 Berray Mountain Cedars
- 018 Roderick Butte

***Botrychium montanum continued***

- 019 Clay Mountain
- 020 French Creek
- 021 Everett Creek
- 022 Red Top Creek
- 024 Sutton Creek
- 025 Mount Baldy
- 026 Houghton Creek
- 027 Keeler Creek
- 028 Sterling Creek
- 029 South Fork Big Creek
- 030 Parsnip Creek
- 031 Beetle Creek
- 032 Upper Turner Creek
- 033 North Fork Meadow Creek
- 034 Arbo Creek

***Botrychium paradoxum***

- 008 Can Creek Drainage
- 009 Can Creek
- 010 Zulu Creek

***Botrychium pedunculosum***

- 001 South Fork Big Creek
- 002 Parsnip Creek
- 003 Keeler Creek
- 004 Sutton Creek
- 005 Big Creek

## APPENDIX C: ECODATA



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM ASCENDENS  
Common Name: UPWARD-LOBED MOONWORT

Global rank: G3? Forest Service status: SENSITIVE  
State rank: S1 Federal Status:

Element occurrence code: PPOPH010S0.002  
Element occurrence type:

Survey site name: WEST FISHER CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: BARREN PEAK

Township: Range: Section: TRS comments:  
026N 030W 4 SE4

Precision: S  
Survey date: Elevation: 3240 -  
First observation: 1995-08-25 Slope/aspect: 5% / SOUTH  
Last observation: 1995-08-25 Size (acres):

Location:  
TAKE HWY 2 TO WEST FISHER ROAD (FS RD 231). TAKE FS RD 231 CA. 0.25  
MILE PAST TURN TO LAKE CREEK CAMPGROUND, AND TURN EAST ONTO OLD ROAD.  
FOLLOW OLD ROAD CA. 0.5 MILE UNTIL IT NEARS DRAW WITH WATER. SITE IS  
CA. 150 FEET BELOW SECTION LINE/STREAM INTERSECTION.

Element occurrence data:

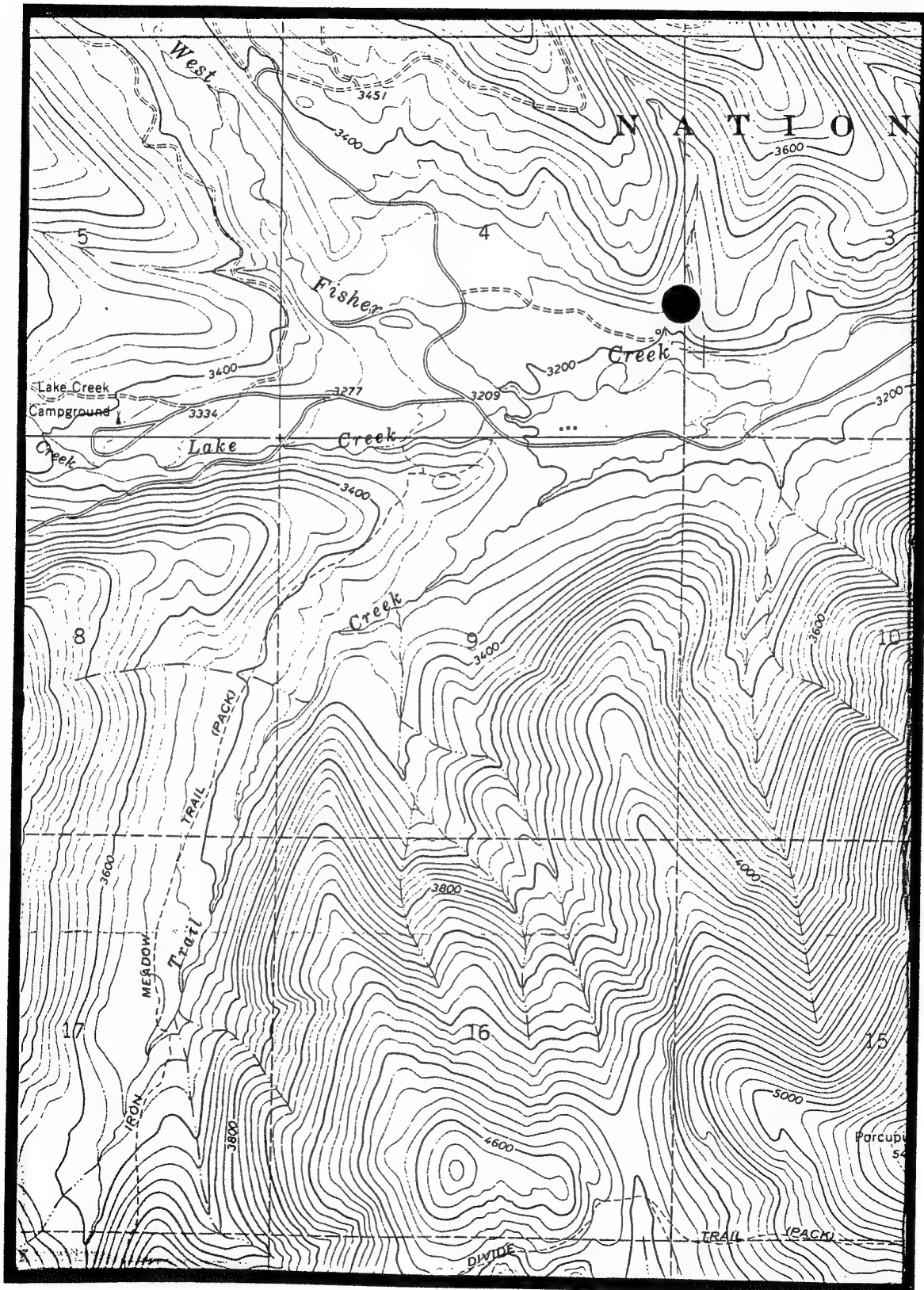
General site description:  
WET TO SATURATED BOTTOM NEAR STREAM. LANDTYPE 108. ASSOCIATED SPECIES:  
ALNUS SINUATA, SYMPHORICARPOS ALBUS, VIOLA GLABELLA, GALIUM TRIFIDUM,  
ANGELICA ARGUTA, MENTHA ARVENSIS, THALICTRUM OCCIDENTALE, CORNUS  
CANADENSIS, ROSA GYMNOCARPA, CORNUS STOLONIFERA, EQUISETUM ARVENSE,  
RIBES LACUSTRE, SMILACINA STELLATA, CIRCAEA ALPINA, GEUM MACROPHYLLUM,  
BOTRYCHIUM VIRGINIANUM, B. MINGANENSE.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
OBSERVED BY J. RENY AND T. BIELAK. DISTURBANCE BY IRON PIPE DOWNSTREAM  
AND SOME GAME TRAILS. ROAD RECONSTRUCTION PROPOSED CA. 78 FEET  
DOWNSTREAM FROM POPULATION.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens: BIELAK, T. (S.N.). 1995. KNF HERBARIUM, LIBBY.



Botrychium ascendens: West Fisher Creek (002)  
USGS Barren Peak 7.5' Quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM ASCENDENS  
Common Name: UPWARD-LOBED MOONWORT

Global rank: G3? Forest Service status: SENSITIVE  
State rank: S1 Federal Status:

Element occurrence code: PPOPH010S0.003  
Element occurrence type:

Survey site name: BEAVER CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: SKILLET MOUNTAIN

Township: Range: Section: TRS comments:  
033N 026W 16 SW4SE4

Precision: S  
Survey date: Elevation: 3650 -  
First observation: 1995-06-21 Slope/aspect: 0% / SOUTH  
Last observation: 1995-06-21 Size (acres):

Location:

SALISH MOUNTAINS. FROM TREGO, GO SOUTH ON FS RD 35 CA. 7 MILES TO  
JUNCTION WITH FS RD 48. TAKE 48 CA. 0.7 MILE TO FS RD 3585. GO UP 3585  
CA. 1 MILE TO GATED SPUR ROAD. POPULATION IS IN CREEK BOTTOM TO EAST  
OF GATE, CA. 0.125 MILE, WEST OF CREEK AND WETLAND.

Element occurrence data:  
6 PLANTS, 100% WITH IMMATURE SPORANGIA.

General site description:

MOIST, PARTIALLY-SHADED ALLUVIAL CREEK BOTTOM IN OPENING IN SPRUCE  
FOREST IN GLACIATED MOUNTAINS. CALCAREOUS ALLUVIUM PARENT MATERIAL,  
CLAY SOIL. LANDTYPE 325. ASSOCIATED SPECIES: PICEA SP., ALNUS INCANA,  
RHAMNUS ALNIFOLIA, CORNUS CANADENSIS, LINNAEA BOREALIS, BOTRYCHIUM  
VIRGINIANUM, B. CRENULATUM, FRAGARIA VIRGINIANUM.

Land owner/manager:  
STATE LAND - UNDESIGNATED

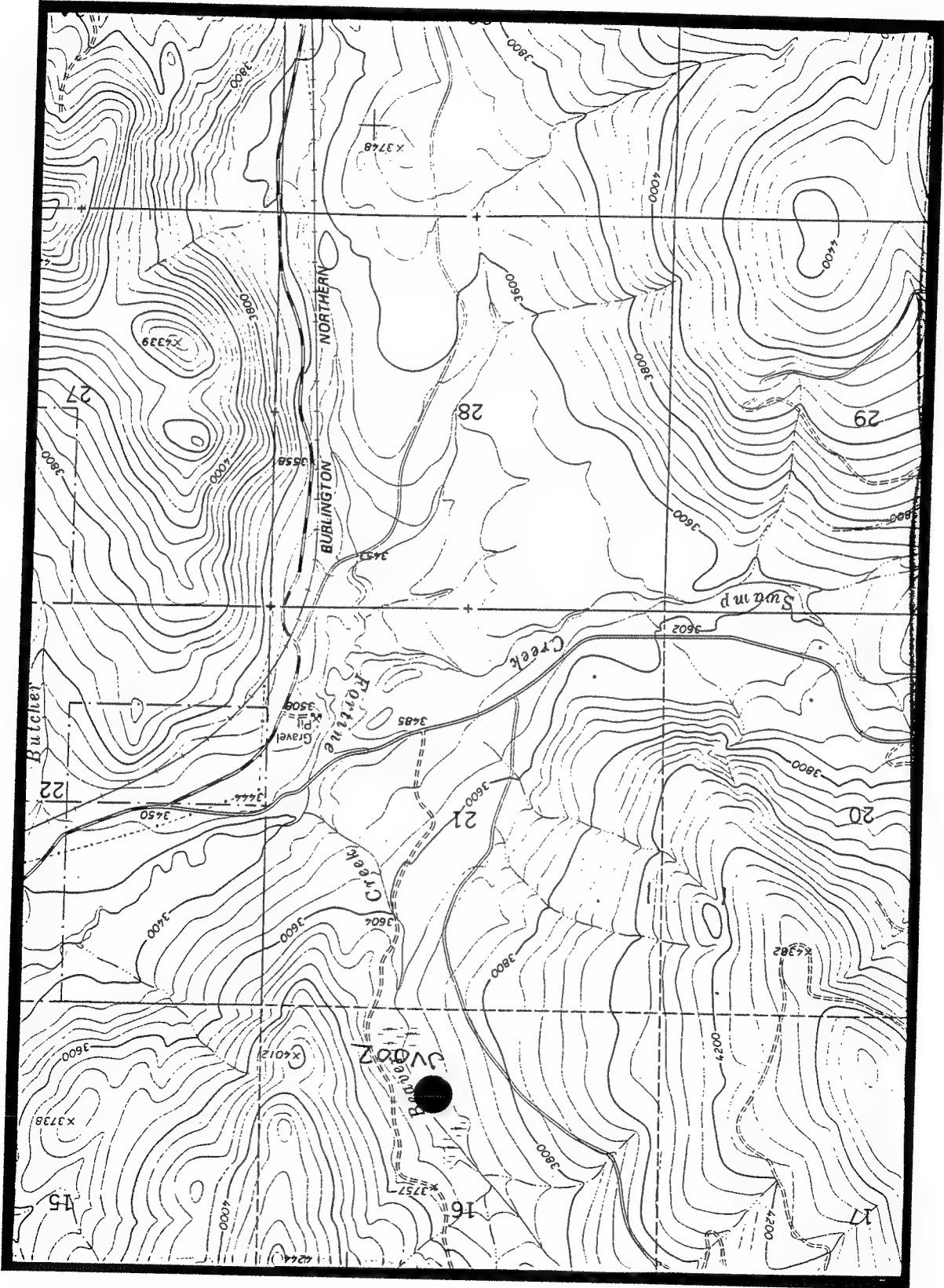
Comments:

SURVEYED BY J. VANDERHORST. SPECIMEN VERIFIED AS B. ASCENDENS BY P.  
ZIKA. ECODATA PLOT FS114395JV002.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5394). 1995. MONTU.

Botrychium ascendens; Beaver Creek (003)  
USGS Skillet Creek 7.5' Quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM CRENULATUM  
Common Name: WAVY MOONWORT

Global rank: G3? Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010L0.002  
Element occurrence type:

Survey site name: ROCK CREEK  
EO rank:  
EO rank comments:

County: SANDERS

USGS quadrangle: NOXON RAPIDS DAM

Township: Range: Section: TRS comments:  
026N 032W 22 SE4

Precision: S  
Survey date: 1996-08 Elevation: 2440 -  
First observation: 1995-06-26 Slope/aspect:  
Last observation: 1995-06-26 Size (acres):

Location:  
ALONG ROCK CREEK, CA. 2.5 AIR MILES NORTHEAST OF NOXON RAPIDS DAM.  
TAKE FS RD 150 EAST FROM HWY 200 CA. 2 MILES TO SITE.

Element occurrence data:  
1996: NO PLANTS FOUND. 1995: 2 PLANTS.

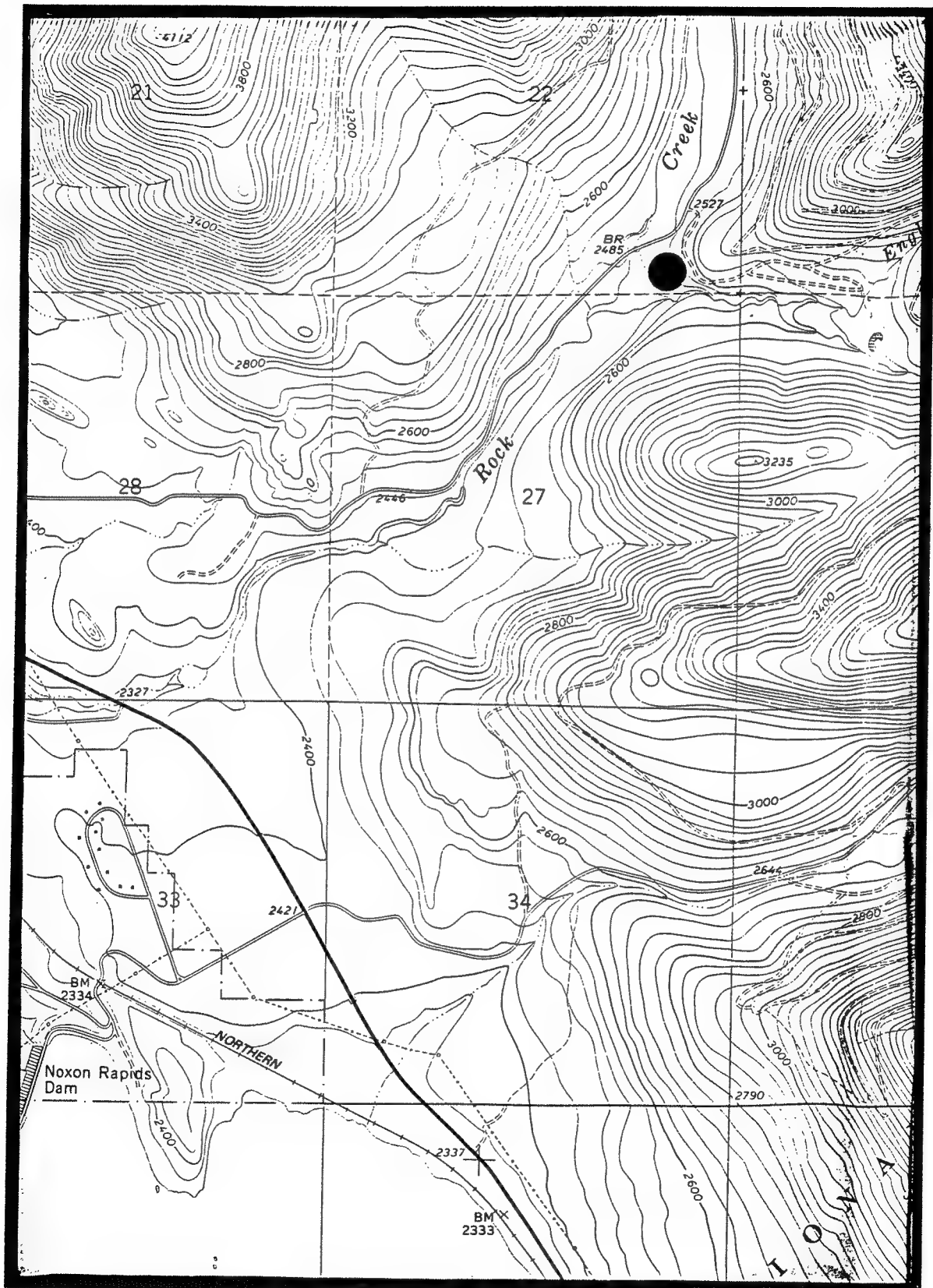
General site description:  
MOIST TERRACE WITH ALLUVIAL PARENT MATERIAL AND FINE-SILTY MIXED,  
FRIGID ANDIC DYSTROCHREPT SOIL. ASSOCIATED SPECIES: BOTRYCHIUM  
LANCEOLATUM, B. MULTIFIDUM, B. VIRGINIANUM, RUBUS URSINUS, GAUTHERIA  
OVALIFOLIA, FRAGARIA VESCA, TSUGA HETEROPHYLLA, ABIES GRANDIS,  
AMELANCHIER ALNIFOLIA, LINNAEA BOREALIS, CLINTONIA UNIFLORA, SMILACINA  
STELLATA, RUBUS PARVIFLORUS, COPTIS OCCIDENTALIS.

Land owner/manager:  
PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)

Comments:  
1996: AREA SURVEYED BY J. ELLIOTT; NO BOTRYCHIUM WERE FOUND. 1995:  
OBSERVED BY J. TREIPKE. INJURY BY TRAMPLING OR STORM.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:



Botrychium crenulatum; Rock Creek (002)  
USGS Noxon Rapids 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM CRENULATUM  
Common Name: WAVY MOONWORT

Global rank: G3? Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010L0.003  
Element occurrence type:

Survey site name: SUTTON CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: BEARTRAP MOUNTAIN

Township: Range: Section: TRS comments:  
035N 028W 33

Precision: M  
Survey date: 1996-07-11 Elevation: 3080 -  
First observation: 1993-07 Slope/aspect: 5% / WNW  
Last observation: 1995-06-27 Size (acres):

Location:  
CA. 1.8 AIR MILES SOUTH OF BEARTRAP MOUNTAIN ALONG SUTTON CREEK. TAKE  
FS RD 619 WEST OF HWY 37 CA. 3.1 MILES.

Element occurrence data:  
1 PLANT, PRODUCING SPOROPHORES.

General site description:  
MOIST, PARTIALLY SHADED VALLEY BOTTOM WITH GLACIAL TILL PARENT  
MATERIAL. LANDTYPES 352, 301. ASSOCIATED SPECIES: CLINTONIA SP.,  
OPLOPANAX SP., ROSA GYMNOCARPA, SYMPHORICARPOS SP., RUBUS PARVIFLORUS,  
LINNAEA SP., FRAGARIA VESCA, VIOLA GLABELLA, V. ORBICULATA, OSMORHIZA  
SP., CORNUS CANADENSIS, BOTRYCHIUM VIRGINIANUM, SMILACINA SP., RIBES  
LACUSTRE, MONESES UNIFLORA, AMELANCHIER SP., MNIMUM SP., BARBILOPHOZIA  
HATCHERI, BRACHYTHECIUM SP., CIRCAEA ALPINA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
1993-1994: OBSERVED BY B. KONCERAK, D. LEAVELL, K. KAISER, J. MINOR,  
AND D. J. RANKOSKY. ECODATA PLOT #FS1140194BK001. AREA SURVEYED BY J.  
VANDERHORST IN 1996: OTHER BOTRYCHIUM SPECIES FOUND BUT B. CRENULATUM  
NOT RELOCATED. POSSIBLE MISIDENTIFICATION IN PREVIOUS YEARS.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:





Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM CRENULATUM  
Common Name: WAVY MOONWORT

Global rank: G3? Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010L0.004  
Element occurrence type:

Survey site name: BASIN CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: ROBINSON MOUNTAIN

Township: Range: Section: TRS comments:  
036N 030W 04 NE4

Precision: S  
Survey date: Elevation: 3860 -  
First observation: 1993 Slope/aspect: 0-3% /  
Last observation: 1996-07-17 Size (acres): 1

Location:  
FROM YAAK FOLLOW FS RD 92 TO THE MAINSTEM AND EAST FORK YAAK RIVER CA.  
16 MILES, THEN TURN ONTO FS RD 337 AND FOLLOW THIS CA. 2 MILES INTO  
SECTION.

Element occurrence data:  
1996: CA. 50 PLANTS. 19 JULY 1995: CA. 50 PLANTS, ALL WITH  
SPOROPHORES, SLIGHTLY YELLOW.

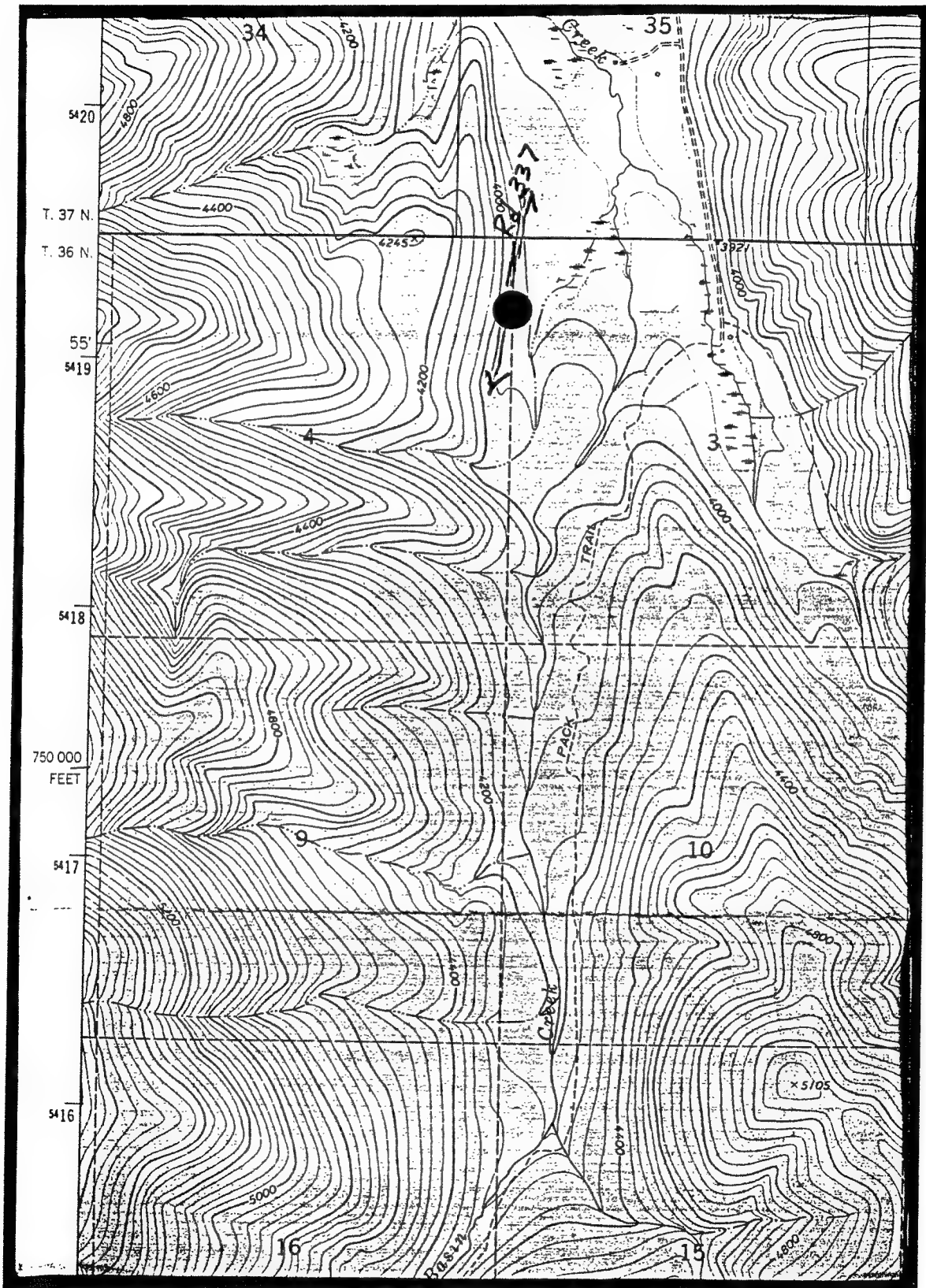
General site description:  
HIGHLY-DISTURBED OPEN ROADSIDE DITCH BOTTOM, SATURATED DURING  
SNOWMELT. VOLCANIC ASH-INFLUENCED LOESS. LANDTYPE 357. ADJACENT FOREST  
PROBABLY TSUGA HETEROPHYLLA/CLINTONIA UNIFLORA. ASSOCIATED SPECIES:  
PARNASSIA PALUSTRIS, ZYGADENUS ELEGANS, FRAGARIA VIRGINIANA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
VERIFICATION FROM W. H. WAGNER IS PENDING. SILHOUETTE OF SPECIMEN  
VERIFIED AS B. CRENULATUM BY P. ZIKA. OBSERVED BY LESLIE FERGUSON.  
ADDITIONAL SUBPOPULATION FOUND IN 1996 BY M. ARVIDSON AND L. SEDLER.  
POPULATION AREA DISTURBED BY LOGGING OPERATION IN AUGUST, 1996 (LOG  
DECK ON SITE). CA. 30 SPECIMENS COLLECTED IN 1996 BY L. SWARTZ (U OF  
ID) FOR DNA AND MORPHOLOGICAL ANALYSIS.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5455). 1995. MONTU.



Botrychium crenulatum: Basin Creek (004)  
USGS Robinson Mountain 7.5' Quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM CRENULATUM  
Common Name: WAVY MOONWORT

Global rank: G3? Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010L0.005  
Element occurrence type:

Survey site name: ALEXANDER MOUNTAIN  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: ALEXANDER MOUNTAIN

Township: . Range: Section: TRS comments:  
031N 029W 19 SW4NW4

Precision: S  
Survey date: Elevation: 4040 - 4200  
First observation: 1994-07-20 Slope/aspect: 4-6 % / SOUTH  
Last observation: 1996-07-29 Size (acres): 1

Location:  
FROM LIBBY, FOLLOW LAKE KOOCANUSA SCENIC BYWAY TO FS RD 4872.

Element occurrence data:  
1996: EST. 50-100 PLANTS. 28 JUNE 1995: 40-50 PLANTS, PROBABLY MORE.  
100% FRUITING.

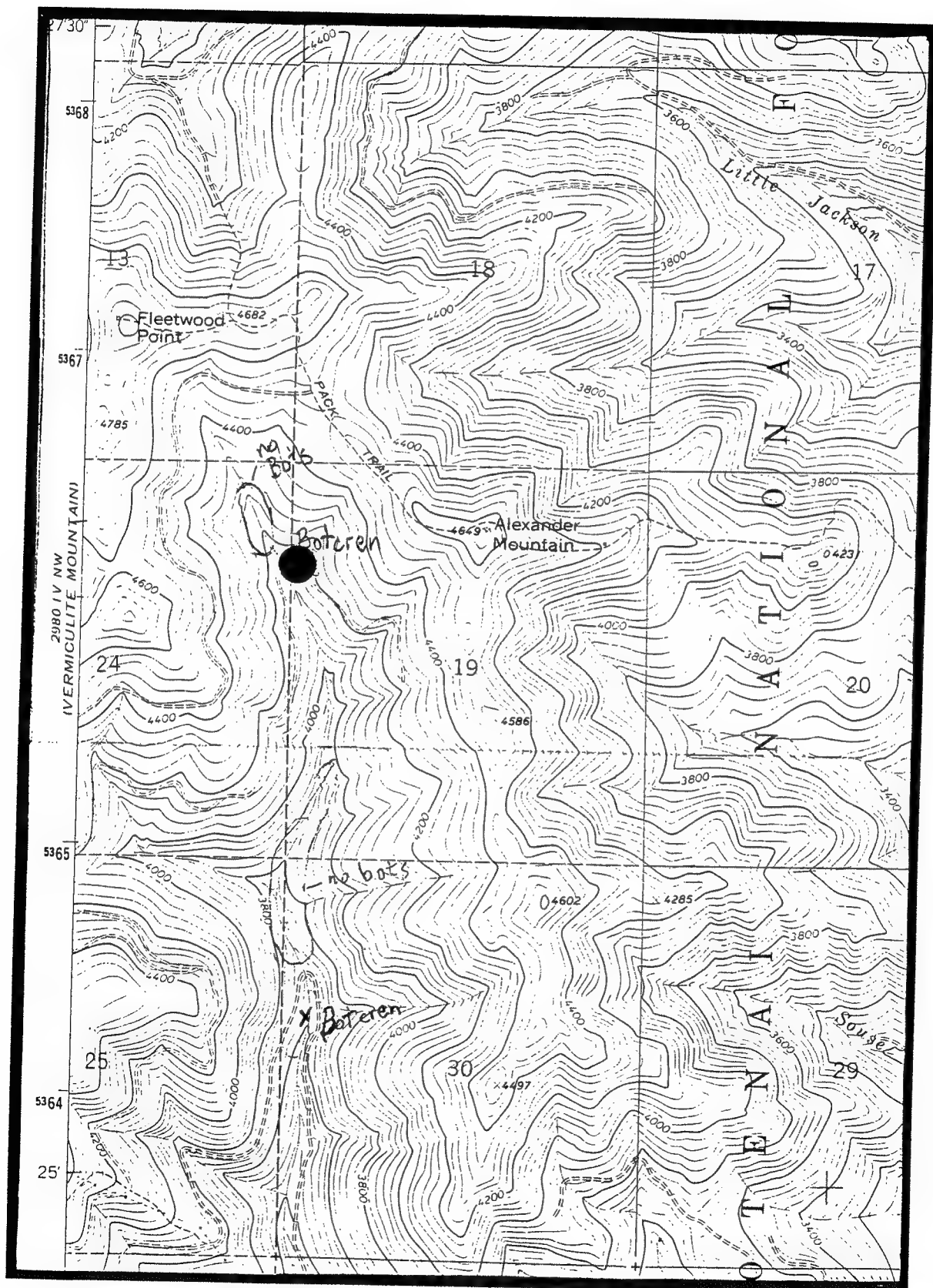
General site description:  
FLAT FLOODPLAIN WITH CALCAREOUS SOIL RECEIVING PARTIAL SUN; SEASONAL  
SEEPAGE. LANDTYPE 325. GRAND FIR-CLINTONIA UNIFLORA/CLINTONIA UNIFLORA  
HABITAT TYPE. ASSOCIATED SPECIES: ABIES GRANDIS, PICEA ENGELMANNII,  
POPULUS TREMULOIDES, SYMPHORICARPOS ALBUS, RUBUS IDAEUS, CORNUS  
STOLONIFERA, ALECTORIA GLABRA, BERBERIS REPENS, ROSA GYMNOCARPA, ALNUS  
SINUATA, RHAMNUS ALNIFOLIA, SOLIDAGO, ACONITUM COLUMBIANUM, MITELLA  
STAUROPETALA, SANICULA MARILANDICA, GALIUM TRIFIDUM, THALICTRUM  
OCCIDENTALE, SMILACINA STELLATA, ACER GLABRUM, ACTAEA RUBRA, TARAXACUM  
OFFICINALE, SMILACINA RACEMOSA, ROSA GYMNOCARPA, LUZULA, EQUISETUM,  
FRAGARIA VESCA, BOTRYCHIUM VIRGINIANUM, POPULUS TRICHOCARPA, GENTIANA  
AMARELLA, ANGELICA ARGUTA, VIOLA GLABELLA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FISHER RIVER RANGER DISTRICT

Comments:  
1996: SURVEYED BY J. VANDERHORST AND J. ELLIOTT. ACTIVE LOG DECK ON  
ROAD JUST ABOVE POPULATION. 1995: VEGETATION SAMPLED USING REPLICATED  
MICROPLOTS BY J. VANDERHORST AND B. HEIDEL. 1994: OBSERVED BY J. RENY,  
L. FERGUSON, T. BIELAK. HIGH GAME USE, TRAILS, MINOR BROWSING.  
SILHOUETTE OF SPECIMEN VERIFIED BY P. ZIKA.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5409). 1995. MONTU.



*Botrychium crenulatum*; Alexander Mountain (005)  
 USGS Alexander Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM CRENULATUM  
Common Name: WAVY MOONWORT

Global rank: G3? Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010L0.007  
Element occurrence type:

Survey site name: BEAVER CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: SKILLET MOUNTAIN

Township: Range: Section: TRS comments:  
033N 026W 16 SW4SE4

Precision: S  
Survey date: Elevation: 3650 -  
First observation: 1995-06-21 Slope/aspect: 0% / SOUTH  
Last observation: 1995-06-21 Size (acres): 1

Location:  
SALISH MOUNTAINS. FROM TREGO, GO SOUTH ON FS RD 36 CA. 7 MILES TO  
JUNCTION WITH FS RD 48. TAKE FS RD 48 CA. 0.7 MILE TO FS RD 3585. GO  
UP 3585 CA. 1 MILE TO GATED SPUR ROAD. POPULATION IS IN CREEK BOTTOM  
TO EAST OF GATE CA. 0.125 MILE WEST OF CREEK AND WETLAND.

Element occurrence data:  
CA. 100 PLANTS, 100% WITH IMMATURE SPORANGIA.

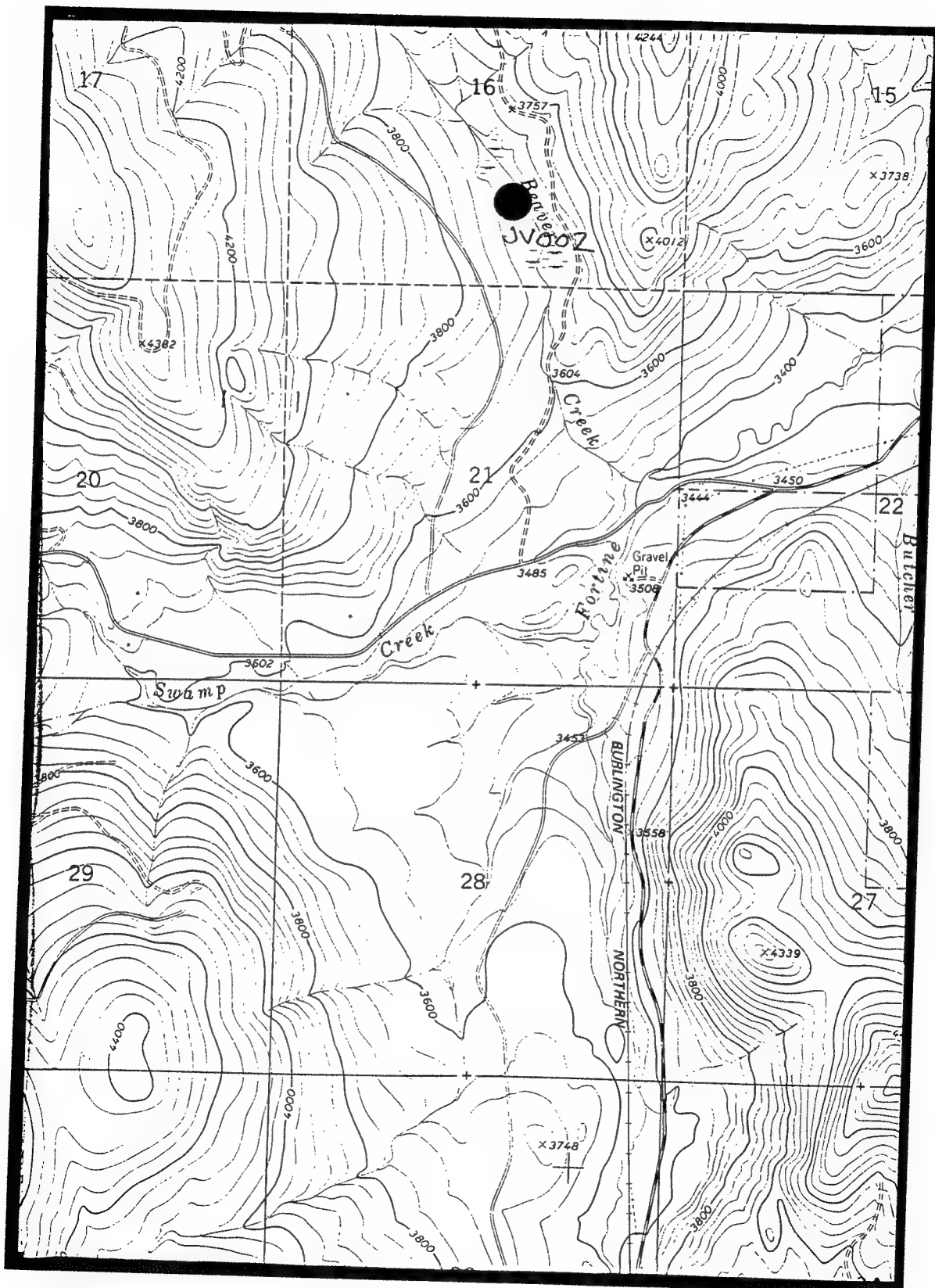
General site description:  
MOIST, PARTIALLY SHADED ALLUVIAL CREEK BOTTOM IN OPENING IN SPRUCE  
FOREST IN GLACIATED MOUNTAINS. LANDTYPE 325. CALCAREOUS ALLUVIUM  
PARENT MATERIAL, CLAY SOIL. ASSOCIATED SPECIES: PICEA SP., ALNUS  
INCANA, RHAMNUS ALNIFOLIA, CORNUS CANADENSIS, LINNAEA BOREALIS,  
BOTRYCHIUM VIRGINIANUM, B. ASCENDENS, FRAGARIA VIRGINIANUM.

Land owner/manager:  
STATE LAND - UNDESIGNATED

Comments:  
SURVEYED BY J. VANDERHORST. SIHLOUETTE OF SPECIMEN VERIFIED BY P.  
ZIKA. ECODATA PLOT FS01140395JV002.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5393). 1995. MONTU.



Botrychium crenulatum; Beaver Creek (007)  
USGS Skillet Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM CRENULATUM  
Common Name: WAVY MOONWORT

Global rank: G3? Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010L0.008  
Element occurrence type:

Survey site name: SWAMP CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: DAVIS MOUNTAIN

Township: Range: Section: TRS comments:  
033N 027W 26 NE4NW4

Precision: S  
Survey date: 1996-07-10 Elevation: 3960 -  
First observation: 1995-08-25 Slope/aspect: LEVEL  
Last observation: 1995-08-25 Size (acres): 10

Location:  
SWAMP CREEK, CA. 11 AIR MILES SW OF TREGO. FROM TREGO, FOLLOW COUNTY  
RT. 36 TO JUNCTION WITH COUNTY RT. 48. FOLLOW 48 CA. 6 MILES TO ASPEN  
GROVE BEFORE BRIDGE ACROSS SWAMP CREEK. ADDITIONAL SUPOPULATION IS CA.  
0.5 MILE UP FS RD 3614 FROM BRIDGE IN ASPEN GROVE.

Element occurrence data:  
1996: NO PLANTS RELOCATED IN NW4 SUBPOPULATION. 1995: <20 PLANTS, 2  
SUBPOPULATIONS, 100% WITH MATURE SPOROPHORES.

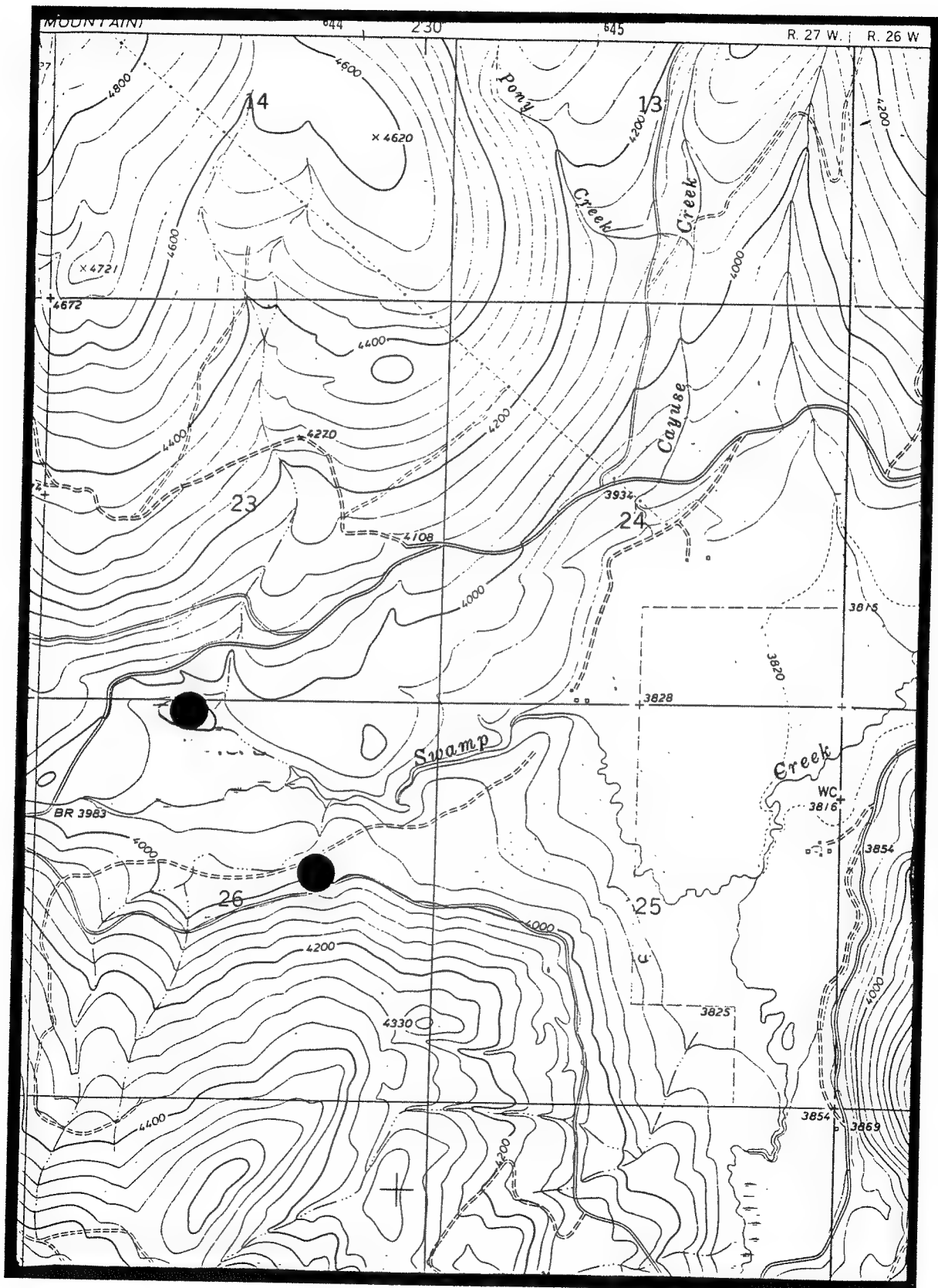
General site description:  
MOIST, PARTIALLY SHADED GLACIATED VALLEY BOTTOM AND LOWERSLOPE.  
LANDTYPES 322, 323. GLACIAL TILL AND ALLUVIUM PARENT MATERIAL, SILTY  
ORGANIC HUMUS SOIL. ASSOCIATED SPECIES: POPULUS TREMULOIDES, P.  
BALSAMIFERA, PICEA ENGELMANNII, CORNUS STOLONIFERA, C. CANADENSIS,  
CAREX AUREA, RUBUS PUBESCENS, BOTRYCHIUM VIRGINANUM, RHAMNUS  
ALNIFLOIA, FRAGARIA VIRGINIANA, EQUISETUM SCIRPOIDES, ELYMUS GLAUCUS,  
PRUNELLA VULGARIS, SYMPHORICARPOS ALBUS, ALNUS SP.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FORTINE RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST. DISTURBANCE BY CLEARCUTS SURROUNDING ASPEN  
GROVES, COWS, AND SLASH BURNS. SOME ASPEN ARE DEAD, PERHAPS DUE TO  
SLASH BURNING OR HYDROLOGICAL EFFECTS OF LOGGING. EARLIER SURVEY IS  
RECOMMENDED; PLANTS ARE CHLOROTIC AND WITHERING. ECODATA PLOT  
#FS01140396JV004

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5549, 5550). 1995. MONTU.



Botrychium crenulatum; Swamp Creek (008)  
USGS Davis Mountain 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: B  
Common Name: WAVY

Global rank: G3?  
State rank: S2

Element occurrence  
Element occurrence

Survey site name:  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: F

Township: Range:  
031N 029W

Precision:  
Survey date:  
First observation:  
Last observation:

Location:  
ALEXANDER CREEK  
UP ALEXANDER C  
CROSSING. PLANT  
OF CREEK.

Element occurrence  
1995: CA. 30 PI  
SPOROPHORES. LC

General site descri:  
MOIST, SHADED  
PARENT MATERIAL  
PLICATA, ALNUS  
SMILACINA STELI  
AMPLEXIFOLIUS,  
VIRGINIANUM, G

Land owner/manager:  
KOOTENAI NATIO

Comments:  
REDUCED NUMBE  
HABITAT CAUSE

Information source

Specimens: VANDER

Scientific Name: BOTRYCHUM CRENULATUM  
Common Name: WAVY MOONWORT

Global rank: G3? Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010L0.011  
Element occurrence type:

Survey site name: BRISTOW CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: URAL

Township: Range: Section: TRS comments:  
032N 029W 15 NE4

Precision: S  
Survey date:  
First observation: 1995-09-01 Elevation: 2600 -  
Last observation: 1995-09-01 Slope/aspect:  
Size (acres):

Location:  
BRISTOW CREEK, CA. 0.3 MILE EAST OF HWY 228 CROSSING, AND CA.  
YARDS UPSTREAM OF CONFLUENCE WITH EVERETT CREEK.

Element occurrence data:

General site description:  
LANDTYPE 102. ASSOCIATED SPECIES: THUJA PLICATA, CORNUS STOLON  
RIBES LACUSTRE, CIRCAEA ALPINA, VIOLA GLABELLA, BOTRYCHUM  
VIRGINIANUM, ALNUS SINUTATA, RUBUS PARVIFLORUS, R. IDAEUS, AST.  
TRILLIUM OVATUM, OSMORHIZA CHILENSIS, GOODYERA OBLONGIFOLIA,  
STREPTOPUS AMPLEXIFOLIUS, CLINTONIA UNIFLORA, ADENOCAULON BICO  
GYMNOCARPIUM DRYOPTERIS, TIARELLA TRIFOLIATA, EQUISETUM SP.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
OBSERVED BY J. RENY.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59

Specimens:



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM CRENULATUM  
Common Name: WAVY MOONWORT

Global rank: G3? Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010L0.012  
Element occurrence type:

Survey site name: WATER TROUGH DRAW  
EO rank:  
EO rank comments:

County: LENCOLN

USGS quadrangle: BEARTRAP MOUNTAIN

Township: Range: Section: TRS comments:  
035N 028W 13 SW4NE4

Precision: S  
Survey date: Elevation: 3860 -  
First observation: 1995-07-21 Slope/aspect: 5% / -  
Last observation: 1996-07-11 Size (acres):

Location:  
CA. 2.3 AIR MILES NORTHEAST OF HELMER MOUNTAIN. TRAVEL SOUTH ON FS RD  
7935 OFF OF FS RD 494. STOP AT FIRST DRAW AND WALK NORTH ALONG CREEK  
BED. SITE IS JUST PAST OLD, GROWN-OVER ROAD.

Element occurrence data:  
1996: 50+ PLANTS IN OLD ROADWAY, 1 PLANT IN CREEK BED ABOVE. 21 JULY  
1995: 4 PLANTS, IN FLOWER.

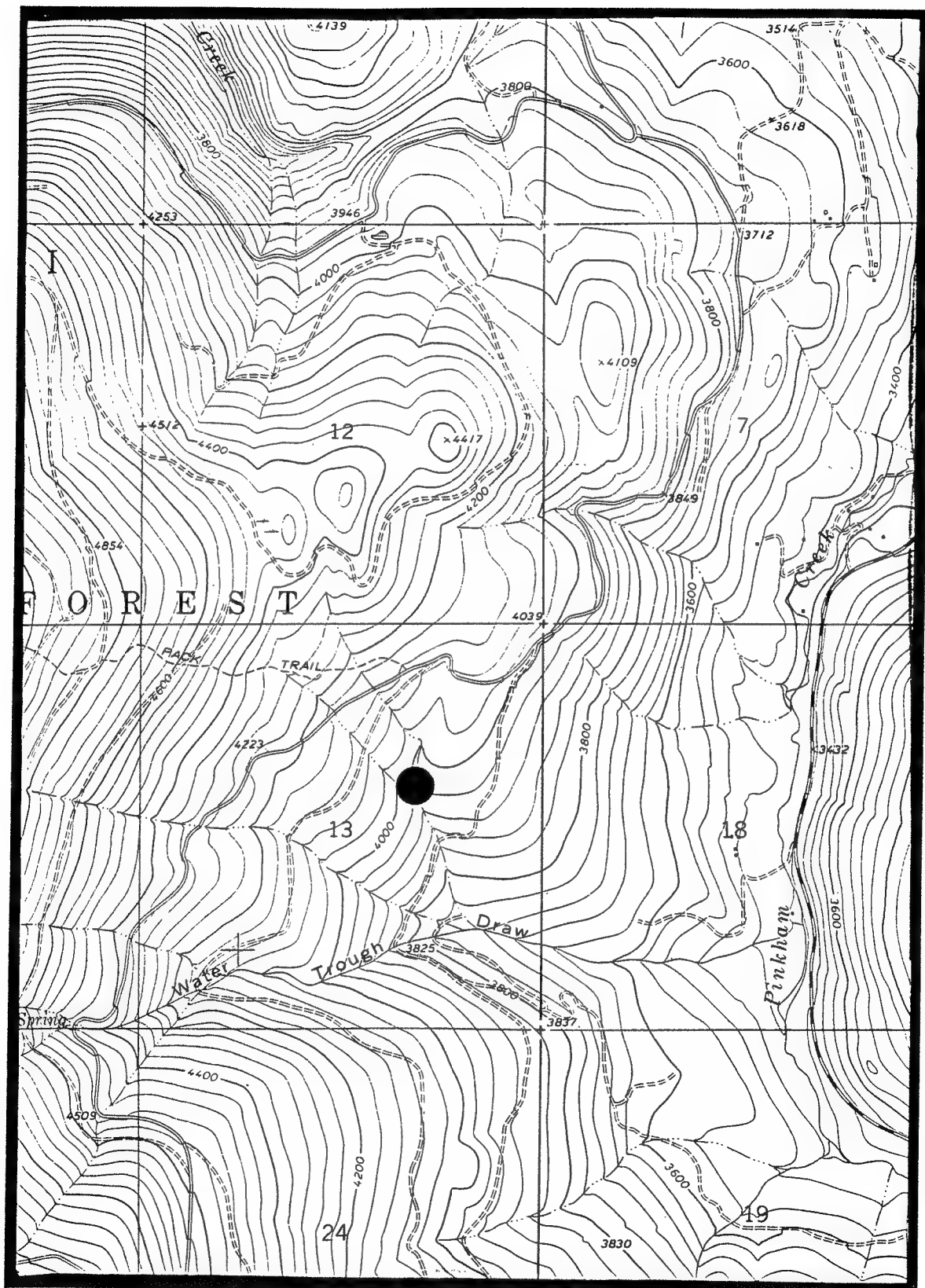
General site description:  
MOIST, OLD STREAM CHANNEL WITH VOLCANIC ASH INFLUENCED LOESS OVERLYING  
DENSE GLACIAL TILL. LANDTYPE 322. ASSOCIATED SPECIES: SYMPHORICARPOS  
ALBUS, SPIRAEA BETULA, ROSA GYMNOCARPA, ANGELICA ARGUTA, SMILACINA  
STELLATA, LONICERA SPP., THALICTRUM OCCIDENTALE, FRAGERIA VIRGINIANA,  
BROMUS VULGARIS, DISPORUM HOODII, OSMORHIZA CHILENSIS, LINNAEA  
BOREALIS, RUBUS PARVIFLORUS, PICEA ENGELMANNII, ERIGERON SPECIOSUS,  
TARAXACUM SPP. 1996: IN ROADWAY WITH TRIFOLIUM REPENS, PRUNUS  
VULGARIS, AGROSTIS STOLONIFERA, POA PRATENSE, PLANTAGO MAJOR,  
CHRYSANTHEMUM LEUCAUTHEMUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
1996: AREA SURVEYED BY J. VANDERHORST. 1995: OBSERVED BY R. LOFTS AND  
J. MINOR. POTENTIAL CATTLE GRAZING.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens: VANDERHORST, J. (5591). 1996. MONTU.



Botrychium crenulatum; Water Trough Draw (012)  
USGS Beartrap Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHUM CRENULATUM  
Common Name: WAVY MOONWORT

Global rank: G3? Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010L0.013  
Element occurrence type:

Survey site name: WOLVERINE CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: KSANKA PEAK

Township: Range: Section: TRS comments:  
037N 025W 18 SW4

Precision: S  
Survey date: Elevation: 5800 - 6000  
First observation: 1996-09 Slope/aspect: / EAST  
Last observation: 1996-09 Size (acres):

Location:  
CA. 7 AIR MILES NORTHEAST OF EUREKA, JUST OUTSIDE THE TEN LAKES SCENIC  
AREA, IN CLEARCUT TO THE SOUTH OF SMALL, UNNAMED LAKE. ACCESS VIA FS  
RD 7086.

Element occurrence data:  
FEWER THAN 20 PLANTS, MATURE AND SPORULATED.

General site description:  
MOIST, OPEN TO PARTIALLY SHADED CLEARCUT. LOCATED IN EARLY TO  
SUCCESSIONAL ANAPHALIS MARGARITACEA COMMUNITIES ON ROADBEDS; LIMESTONE  
ROCK WITH SILICEOUS INCLUSIONS, SURROUNDED BY ALNUS SINUATA THICKETS  
AND SPRUCE AND FIR REGENERATION.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FORTINE RANGER DISTRICT

Comments:  
OBSERVED BY T. SPRIBILLE. ROADS LAST USED CA. 20-30 YEARS AGO.

Information source: SPRIBILLE, TOBY. BOX 2106, COLUMBIA FALLS, MONTANA  
59912.

Specimens: SPRIBILLE, T. (S.N.). 1996. FORTINE RD HERBARIUM.



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM CRENULATUM  
Common Name: WAVY MOONWORT

Global rank: G3? Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010L0.015  
Element occurrence type:

Survey site name: BLUEBIRD LAKE  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: KSANKA PEAK

Township: Range: Section: TRS comments:  
037N 026W 25 NW4 (UNSURVEYED SECTION)

Precision: S  
Survey date: Elevation: 6840 -  
First observation: 1995-09-25 Slope/aspect:  
Last observation: 1995-09-25 Size (acres):

Location:  
WHITEFISH RANGE. TEN LAKES SCENIC AREA, ON SMALL MORaine JUST EAST OF  
BLUEBIRD LAKE ON TRAIL #88.

Element occurrence data:  
3 OR 4 PLANTS FOUND, BUT ENTIRE AREA NOT SEARCHED.

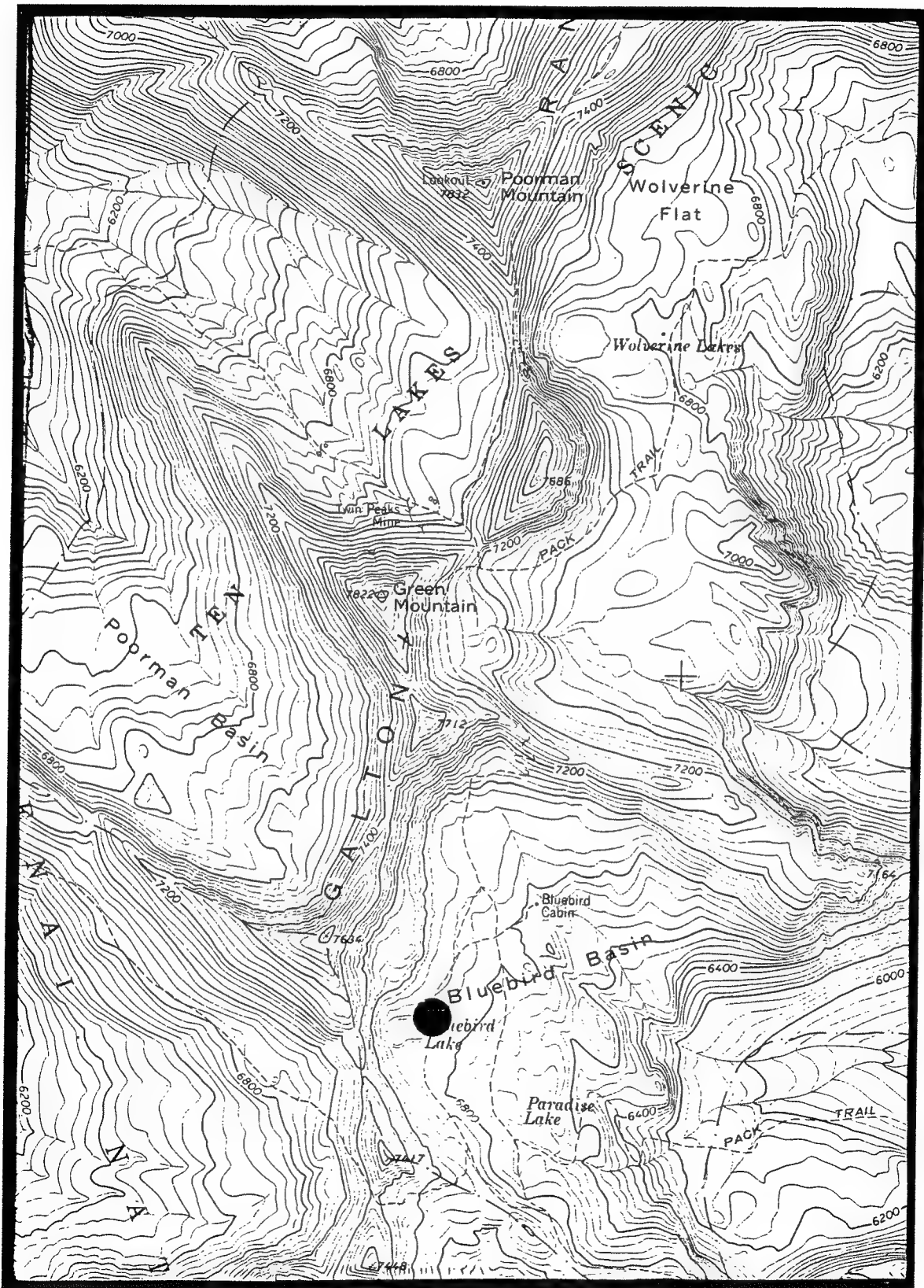
General site description:  
IN ROCKY ASTER FOLIACEUS-DOMINATED SUBALPINE MEADOW, BENEATH  
ARGILLITIC BOULDER LEDGES, WITH VALERIANA SITCHENSIS, MELICA  
SPECTABILIS, PHLEUM COMMUTATUM, AGOSERIS AURANTIACA, ERYTHRONIUM  
GRANDIFLORUM. LANDTYPE 405.

Land owner/manager:  
TEN LAKES SCENIC AREA  
KOOTENAI NATIONAL FOREST, FORTINE RANGER DISTRICT

Comments:  
OBSERVED BY T. SPRIBILLE.

Information source: SPRIBILLE, TOBY. FORTINE RANGER DISTRICT. P.O. BOX  
116, FORTINE, MT 59918.

Specimens:



Botrychium crenulatum; Bluebird Lake (015)  
USGS Ksanka Peak 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM CRENULATUM  
Common Name: WAVY MOONWORT

Global rank: G3? Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010L0.016  
Element occurrence type:

Survey site name: GREEN MOUNTAIN  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: KSANKA PEAK

Township: Range: Section: TRS comments:  
037N , 026W 23 NE4 (UNSURVEYED SECTION)

Precision: S  
Survey date: Elevation: 7680 -  
First observation: 1995-09-25 Slope/aspect:  
Last observation: 1995-09-25 Size (acres):

Location:  
WHITEFISH RANGE, TEN LAKES SCENIC AREA. JUST SOUTH OF GREEN MOUNTAIN  
ON EAST SIDE OF RIDGELINE. ACCESSIBLE BY HIKING EAST FROM TRAIL 88 IN  
THE WOLVERINE BASIN.

Element occurrence data:  
CA. 25 PLANTS.

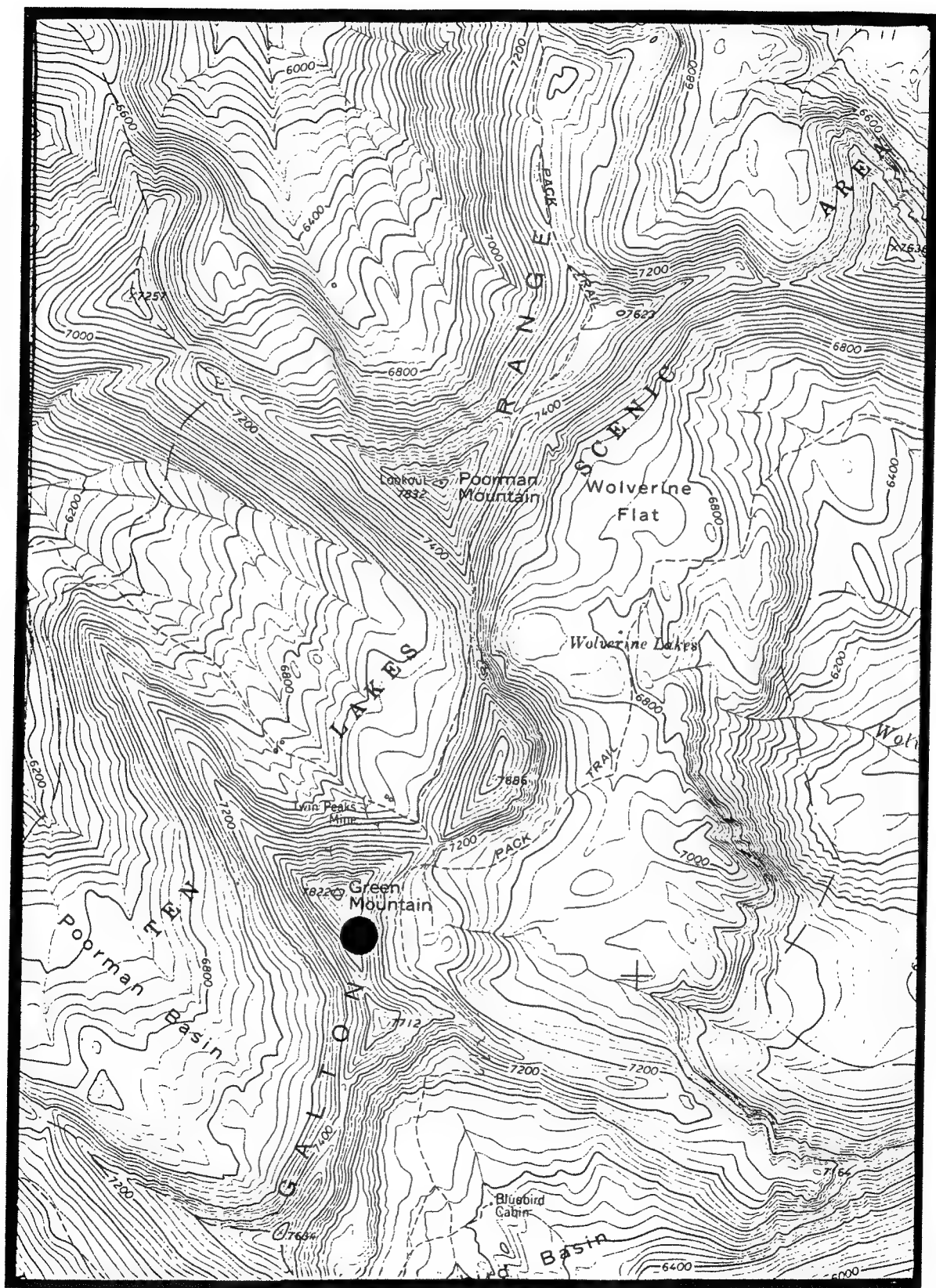
General site description:  
GRAVELLY ALPINE SLOPES, ON FINE GRAVELLY MATERIAL BENEATH ARENITE  
LEDGES. LANDTYPE 403. ASSOCIATED SPECIES: ANTENNARIA UMBRINELLA,  
ACHILLEA MILLEFOLIUM, POTENTILLA DIVERSIFOLIA, ARENARIA CAPILLARIS,  
ANEMONE MULTIFIDA, SOLIDAGO MULTIRADIATA, CYSTOPTERIS FRAGILIS.

Land owner/manager:  
TEN LAKES SCENIC AREA  
KOOTENAI NATIONAL FOREST, FORTINE RANGER DISTRICT

Comments:  
OBSERVED BY T. SPRIBILLE.

Information source: SPRIBILLE, TOBY. FORTINE RANGER DISTRICT. P.O. BOX  
116, FORTINE, MT 59918.

Specimens:



Botrychium crenulatum; Green Mountain (016)  
USGS Ksanka Peak 7.5' quadrangle

MONT

Scientific Name: BOTRYCH.  
Common Name: WAVY MOONWO

Global rank: G3? For  
State rank: S1

Element occurrence code:  
Element occurrence type:

Survey site name: STEWART  
EO rank:  
EO rank comments:

County: FLATHEAD

USGS quadrangle: SKILLET

Township: Range: Section  
033N 025W 18

Precision: S  
Survey date:  
First observation: 1995-0  
Last observation: 1995-0

Location:  
FROM HWY 93 SOUTH OF E  
TREGO TO STEWART CREEK  
SWITCHBACK AND PARK. P

Element occurrence data:  
20-30 PLANTS, WITH MAT

General site description:  
OPEN, MESIC ROADSIDE HA  
TYPE WITH FINE, SILTY I  
VIRGINIANA, POA PRATENS

Land owner/manager:  
KOOTENAI NATIONAL FORES

Comments:  
OBSERVED BY J. TRIEPKE  
TRAMPLING, TRAFFIC, PA

Information source: SENSIT  
FOREST

Specimens:

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service stat  
State rank: S2S3 Federal St

Element occurrence code: PPOPH010R0.01C  
Element occurrence type:

Survey site name: ROSS CREEK CEDAR GRO  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: SAWTOOTH MOUNTAIN

Township: Range: Section: TRS commen  
028N 034W 12

Precision: S  
Survey date: Ele  
First observation: 1994-07-10 Slc  
Last observation: 1995-07-16 Siz

Location:  
ROSS CREEK CEDAR GROVE. FROM PARKIN  
LEFT AT FIRST FORK. PLANTS ARE CA.  
OF TRAIL, CA. 15 FEET FROM TRAIL. I  
FLOODPLAIN CHANNEL ACROSS TRAIL FR  
"FAIRIES NEST."

Element occurrence data:  
1995: 15 PLANTS ALONG 100 FT OF MO.  
2 PATCHES IN A 10 x 10 FOOT AREA.

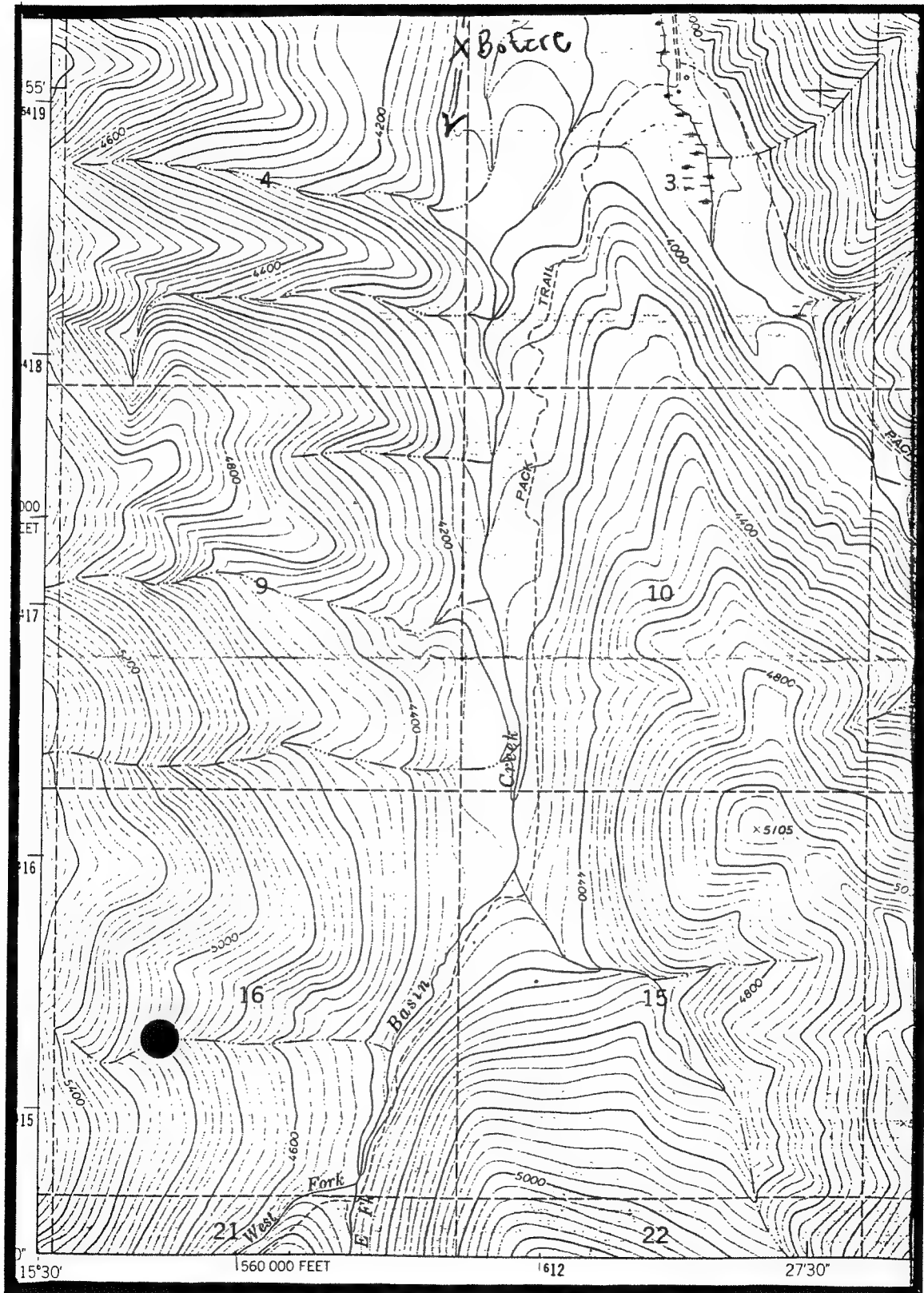
General site description:  
>90% CANOPY COVERAGE, ANCIENT CEDA  
SPECIES: THUJA PLICATA, GYMNOCARPI  
FILIX-FEMINA, ASARUM CANDATUM, TIA

Land owner/manager:  
ROSS CREEK CEDARS SCENIC AREA  
LOWER ROSS CREEK PROPOSED RESEARCH  
KOOTENAI NATIONAL FOREST, THREE RI

Comments:  
OBSERVED BY C. LOGGERS, K. AHLENS  
VANDERHORST IN 1995.

Information source: VANDERHORST, J.  
MT 59935.

Specimens: VANDERHORST, J. (5552). 1



Botrychium minganense; Basin Creek (016)  
USGS Robinson Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4      Forest Service status: SENSITIVE  
State rank: S2S3      Federal Status:

Element occurrence code: PPOPH010R0.017  
Element occurrence type:

Survey site name: BUNKER HILL CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: MOUNT HENRY

Township: Range: Section: TRS comments:  
036N      031W      10      NW4

Precision: S  
Survey date:      Elevation: 4320 -  
First observation: 1993-08      Slope/aspect: - / NORTH  
Last observation: 1996-08-12      Size (acres): 1

Location:  
FROM LIBBY, GO CA. 27 MILES GENERALLY NORTH ON COUNTY RTE 68, THEN GO  
CA. 6 MILES ON COUNTY RTE 746 INTO FS RD 6047. TAKE THIS ROAD CA. 2.5  
MILES TO SITE.

Element occurrence data:  
1996: 50+ LARGE, VIGOROUS PLANTS. 1993: 25 OR FEWER INDIVIDUALS.

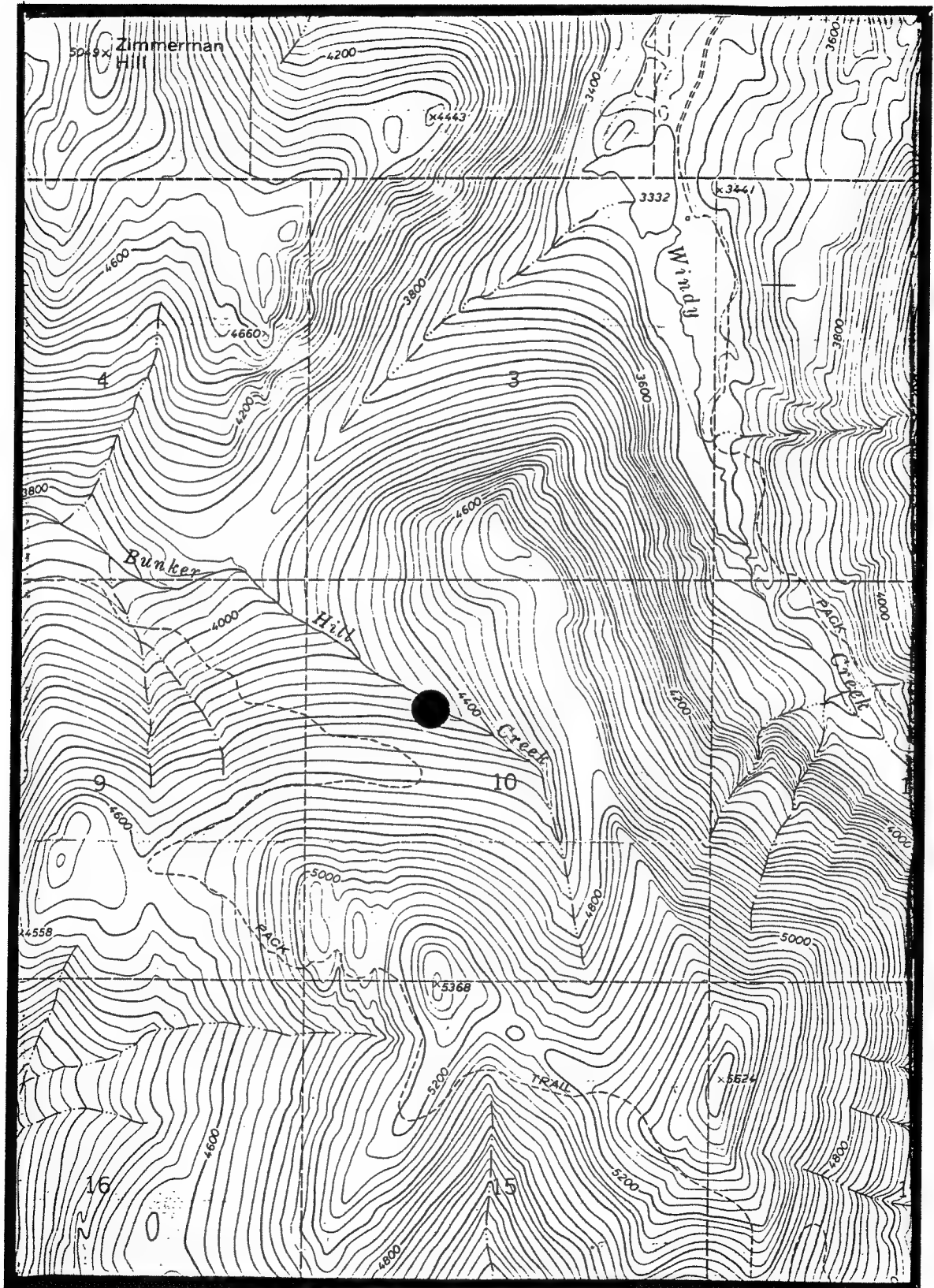
General site description:  
MOIST, SHADED MIDSLOPE. LANDTYPE 352. MATURE WESTERN RED CEDAR STAND.  
THUJA PLICATA/OPLOPANAX HORRIDUM HT, WITH ATHYRIUM FILIX-FEMINA,  
CLINTONIA UNIFLORA, ALNUS SP.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
SURVEYED BY J. VANDERHORST IN 1996; ECODATA PLOT FS011R0496JV015.  
OBSERVED BY TOM DESY IN 1993.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens: VANDERHORST, J. (5619). 1996. MONTU.



Botrychium minganense; Bunker Hill Creek (017)  
USGS Mount Henry 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.018  
Element occurrence type:

Survey site name: CAN CREEK DRAINAGE  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: PINK MOUNTAIN

Township: Range: Section: TRS comments:  
035N 031W 32 SE4

Precision: S  
Survey date: Elevation: 4280 - 4440  
First observation: 1993-07-30 Slope/aspect: 50% / NORTH-NW  
Last observation: 1996 Size (acres): 5

Location:  
IN DRAW OF CAN CREEK DRAINAGE, CA. 2.1 AIR MILES WNW OF PINK MOUNTAIN  
AND CA. 8 MILES SOUTHEAST OF YAAK.

Element occurrence data:  
1996 AND 22 AUGUST 1995: ONLY B. MONTANUM FOUND. 1993: 50-100 PLANTS  
OF DIFFERENT SPECIES WITH SPOROPHORES.

General site description:  
LANDTYPE 352. IN GENUS COMMUNITY MADE UP OF B. MINGANENSE, B.  
MONTANUM, AND B. PARADOXUM. MOIST, PARTIALLY SHADED LOWERSLOPE/BOTTOM.  
WESTERN HEMLOCK/CLINTONIA UNIFLORA/CLINTONIA UNIFLORA HABITAT TYPE.  
YOUNG TO MATURE WESTERN RED CEDAR OVERSTORY. ASSOCIATED SPECIES: RIBES  
LACUSTRE, BERBERIS REPENS, ASTER SPP., ROSA GYMNOCARPA, VIOLA  
ORBICULATA, LINNAEA BOREALIS, SPIRAEA BETULIFOLIA, VACCINIUM  
SCOPARIUM, CHIMAPHILA UMBELLATA, LONICERA UTAHENSIS, SMILACINA  
STELLATA, OSMORHIZA CHILENSIS. COMPLETE LIST ON FILE AT MTHP.

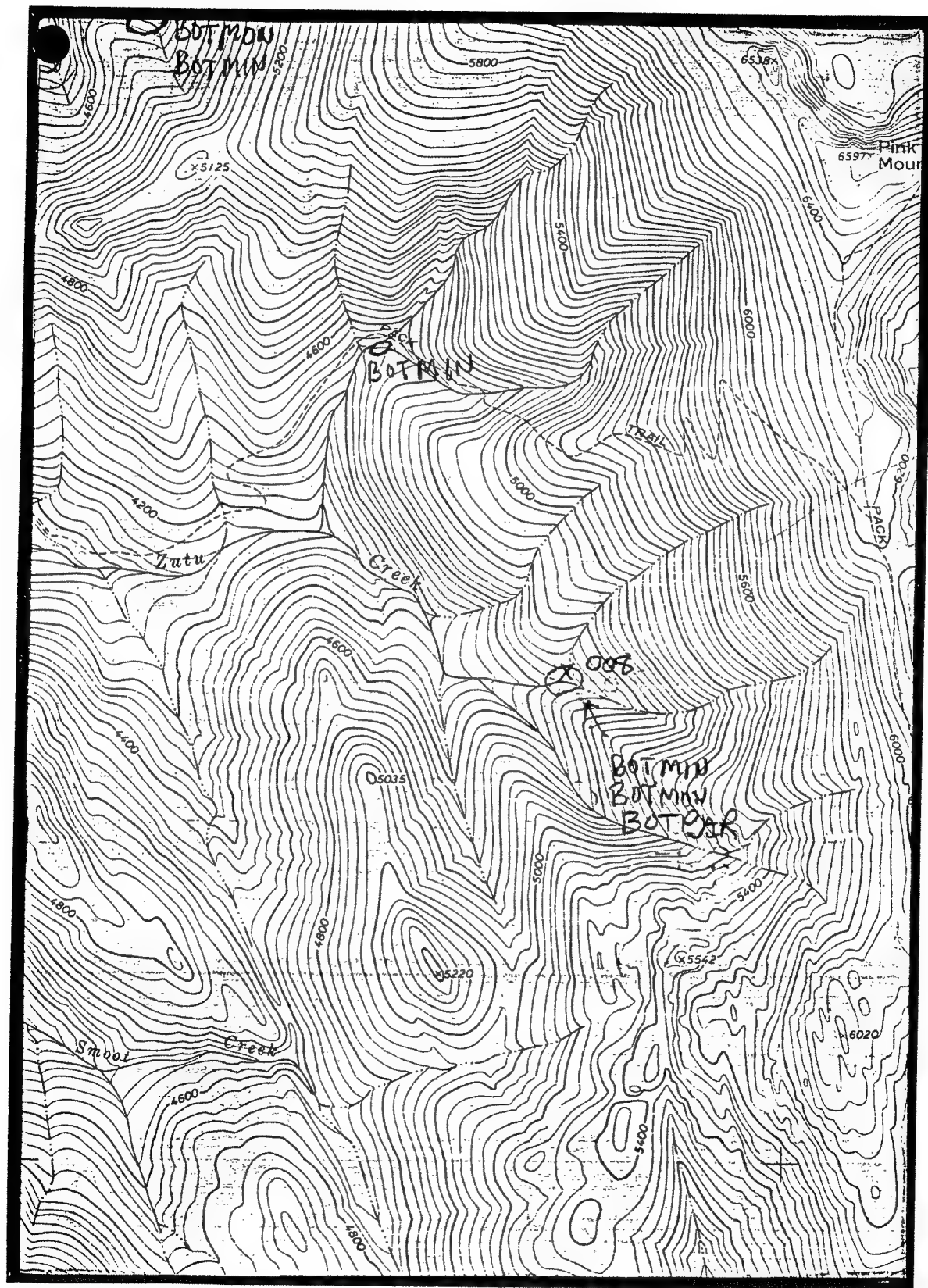
Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY LESLIE FERGUSON. SITE MAY HAVE CEDAR TYPE MICROSITES. SITE  
REVISITED IN 1995 AND 1996 BY J. VANDERHORST. ECODATA PLOT  
FS01140496JVO16.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:





Botrychium manganense; Can Creek Drainage (018)  
 USGS Pink Mountain 7.5' quadrangle  
 (top left corner)



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.019  
Element occurrence type:

Survey site name: LITTLE CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: CLARK MOUNTAIN

Township: Range: Section: TRS comments:  
035N 033W 28 SE4SE4; 27 SW4; 34 SW4NW4

Precision: S  
Survey date: Elevation: 4800 -  
First observation: 1993-07-06 Slope/aspect: 10-50% SW  
Last observation: 1995-07-21 Size (acres):

Location:  
HEAD SOUTHWEST FROM YAAK CA. 2.5 MILES ON STATE HWY 508. TURN ONTO  
COUNTY RTE 593 AND HEAD GENERALLY WEST CA. 6.5 MILES TO FS RD 902.  
FOLLOW THIS ROAD CA. 8 MILES. PLANTS ARE BEHIND GATE.

Element occurrence data:  
1995: SOUTHERN SUBPOPULATION LOCATED WITH CA. 50 PLANTS. 1993: 20-40  
PLANTS (OF CA. 5 DIFFERENT BOTRYCHIUM SPECIES), ALL WITH SPOROPHORES.

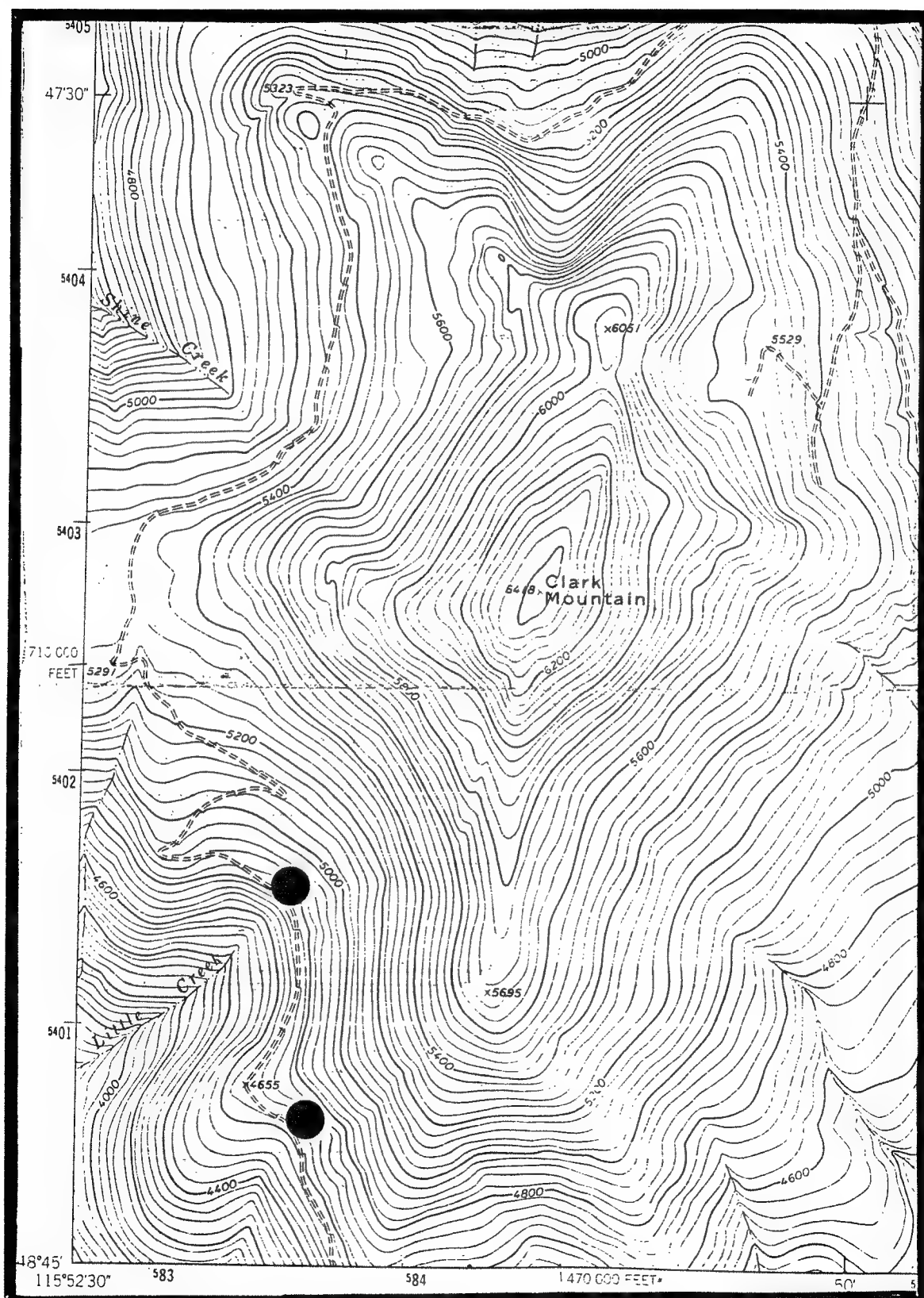
General site description:  
MOIST, SHADED MIDSLOPE. LANDTYPE 522. OLD-GROWTH WESTERN RED CEDAR,  
SOME SPRUCE. NO BREAK IN CANOPY CLOSURE. BOTRYCHIUM GENUS COMMUNITY.  
WITH TIABELLA TRIFOLIATA, HABENARIA SACCATA, SANICULA MARYLANDICA,  
BOTRYCHIUM VIRGINIANUM, B. PINNATUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
VERIFICATION FROM W. H. WAGNER IS PENDING. OBSERVED BY TOM DESY AND  
LESLIE FERGUSON IN 1993 AND BY J. VANDERHORST IN 1995.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5461). 1995 MONTU.



Botrychium minganense; Little Creek (019)  
USGS Clark Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.020  
Element occurrence type:

Survey site name: FAWN CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: FISHER MOUNTAIN

Township: Range: Section: TRS comments:  
029N 029W 30 SW4  
029N 030W 36 NE4

Precision: S  
Survey date: Elevation: 3680 - 3920  
First observation: 1993-07-29 Slope/aspect: 12-13% / NORTH  
Last observation: 1995-07-13 Size (acres): 1

Location:  
FROM CANOE GULCH RANGER STATION, TAKE FS RD 759 SOUTH CA. 7 MILES AND  
TURN ONTO DOE CREEK ROAD (FS RD 534) TO FAWN CREEK TRAIL (FS RD 6735).  
STAY LEFT AND GO TO END OF ROAD. WALK DIRECTLY TOWARD CREEK AND FOLLOW  
BLAZED TRAIL PAST MARSHY AREA TO SMALL CAMPSITE. WHEN TRAIL STARTS  
CLIMBING, LOOK FOR WETLAND AREA ON RIGHT.

Element occurrence data:  
1995: 41 PLANTS, FLOWERING (SPORULATING), EARLY STAGES ON MATURE  
FRONDS. 1993: 15-20 PLANTS, SPORES BEING RELEASED.

General site description:  
OPEN, BOGGY, STRAIGHT STREAM CONFLUENCE. LANDTYPE 352. TSUGA  
HETEROPHYLLA/CLINTONIA UNIFLORA/ARALIA NUDICAULIS HABITAT TYPE.  
ASSOCIATED SPECIES: SYMPHORICARPOS ALBUS, ATHYRIUM FILIX-FEMINA,  
EQUISETUM ARVENSE, PYROLA ASARIFOLIA, P. CHLORANTHA, SMILACINA  
STELLATA, VIOLA GLABELLA, VIOLA SPP., CALAMAGROSTIS CANADENSIS, ELYMUS  
SP., RUBUS IDAEUS, THALICTRUM OCCIDENTALE, BOTRYCHIUM VIRGINIANUM,  
SALIX SP. ADDITIONAL ASSOCIATED SPECIES ON FILE AT MTHP.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FISHER RIVER RANGER DISTRICT

Comments:  
SITE RELOCATED IN 1995 BY T. BIELAK, J. RENY, AND N. BANISTER.  
VERIFICATION FROM W. H. WAGNER IS PENDING. OBSERVED BY PENNY LATHAM  
AND JON RENY IN 1993. WILDLIFE TRAILS AND BEDS; SOME FERTILE FRONDS  
HAVE BEEN NIPPED.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens: LATHAM, P. AND J. RENY. (S.N.). 1993. LIBBY SO.



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.021  
Element occurrence type:

Survey site name: FRENCH CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: BONNET TOP  
GARVER MOUNTAIN

Township: Range: Section: TRS comments:  
037N . 032W 34 SE4, SE4SW4  
036N 032W 05 N2; 4 NW4

Precision: S  
Survey date: Elevation: 3920 - 4600  
First observation: 1993-08-29 Slope/aspect: LEVEL-GENTLE / EAST-NE  
Last observation: 1996-09-03 Size (acres): 8

Location:  
FROM YAAK, TAKE FS RD 92 NORTH AND TURN ONTO FS RD 276 AT LOWER FALLS.  
FOLLOW THIS ROAD AS IT TURNS INTO FS RD 5857 AND INTO SECTION.

Element occurrence data:  
1996: FEWER PLANTS FOUND THAN IN 1995. 17 JULY 1995: SUBPOPULATION IN  
SEC. 34 WITH 50 B. MINGANENSE PLANTS ESTIMATED. 1993: 8  
SUBPOPULATIONS, ALL WITH SPOROPHORES, 5 WITH 25-50 PLANTS.

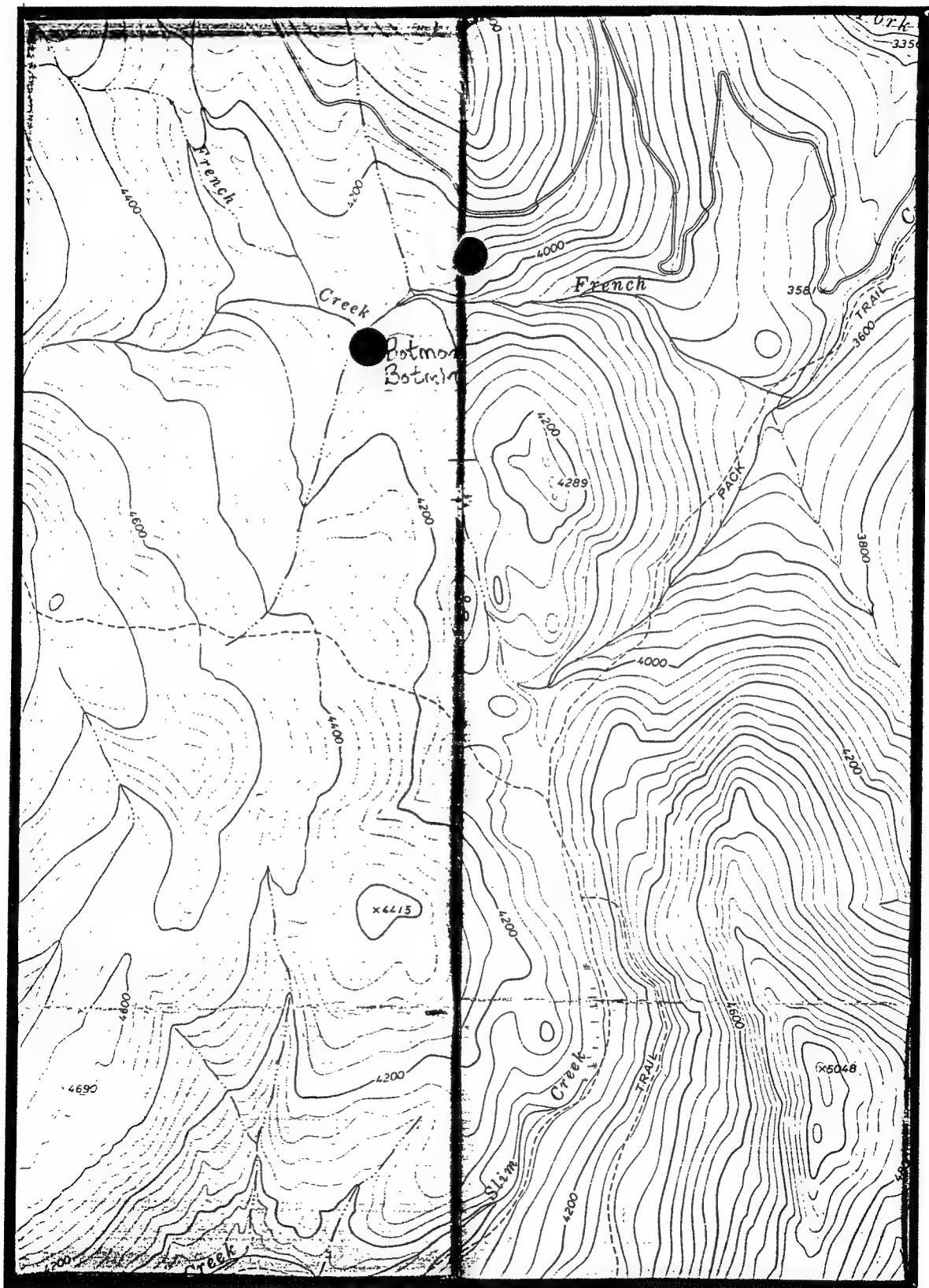
General site description:  
MOIST TO SATURATED LOWERSLOPE, SHADED TO PARTIAL SUN. LANDTYPE 352.  
TSUGA HETEROPHYLLA/CLINTONIA UNIFLORA HABITAT TYPE. ASSOCIATED  
SPECIES: BOTRYCHIUM VIRGINIANUM, B. MONTANUM, B. SPP., ACTAEA RUBRA,  
OTHER WET-SITE FORBS, WESTERN RED CEDAR, WESTERN LARCH, ENGELMANN  
SPRUCE, WHITE PINE, ALPINE FIR.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
VERIFICATION FROM W. H. WAGENR IS PENDING. OBSERVED BY LESLIE  
FERGUSON. ONE POPULATION IS LOCATED IN HARVEST AREA THAT HAS NOT BEEN  
DROPPED. SITE REVISITED IN 1995 BY J. VANDERHORST AND L. FERGUSON, AND  
IN 1996 BY VANDERHORST (ECODATA PLOT FS01140296JV003). MONITORING  
TRANSECTS ESTABLISHED 07-17-95. PHOTOCOPY OF SPECIMEN DETERMINED B.  
MINGANENSE BY P. ZIKA.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5452). 1995. MONTU.



Botrychium minganense; French Creek (021)  
USGS Bonnet Top and Garver Mountain 7.5' quadrangles

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4      Forest Service status: SENSITIVE  
State rank: S2S3      Federal Status:

Element occurrence code: PPOPH010R0.022  
Element occurrence type:

Survey site name: HOUGHTON CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: MILLER LAKE

Township: Range: Section: TRS comments:  
026N      029W      24

Precision: M  
Survey date:      Elevation: 4200 -  
First observation: 1993-08-20      Slope/aspect: 10% / WEST  
Last observation: 1993-08-25      Size (acres):

Location:  
CA. 24 MILES SOUTHEAST OF LIBBY. TAKE US HWY 2 TO MCGINNIS ROAD  
(COUNTY RTE 516) TO HOUGHTON CREEK (VIA FS RD 6761).

Element occurrence data:  
38 SMALL, IMMATURE PLANTS; SPORES NOT YET RELEASED.

General site description:  
WARM, MOIST DUFF, PARTIALLY SHADED STREAM CONFLUENCE (MIDDLE OF  
SECTION) AND STREAM RECEIVING FULL SUNLIGHT (BOTTOM OF SECTION).  
LANDTYPE 355. ALNUS INCANA DOMINANCE TYPE. ABIES GRANDIS/CLINTONIA  
UNIFLORA/ARABIS NUTTALII HABITAT TYPE. ASSOCIATED SPECIES: CORNUS  
STOLONIFERA, RUBUS PARVIFLORUS, SYMPHORICARPOS ALBUS, ACER GLABRUM,  
SMILACINA STELLATA, GALIUM TRIFIDUM, CIRSIIUM, SENECIO TRIANGULARIS,  
THALICTRUM OCCIDENTALE, PYROLA CHLORANTHA, VIOLA SP., CORNUS  
CANADENSIS, EPILOBIUM GLABERRIMUM, EQUISETUM, GYMNOCARPIUM DRYOPTERIS,  
BOTRYCHIUM VIRGINIANUM. B. ASCENDENS. ADDITIONAL SPECIES ON FILE AT  
MTHP.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FISHER RIVER RANGER DISTRICT  
CORPORATE TIMBERLANDS

Comments:  
OBSERVED BY PEGGY LATHAM AND JON RENY. GAME USE HEAVY (TRAILS,  
BROWSE); BEAR SCAT PRESENT; WINDTHROW.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:





Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.025  
Element occurrence type:

Survey site name: KELSEY CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: YAAK

Township: Range: Section: TRS comments:  
035N 031W 29 SW4 (UNSURVEYED SECTION)

Precision: S  
Survey date: Elevation: 3860 - 4000  
First observation: 1992 Slope/aspect: 0-5% / WEST  
Last observation: 1996-07-30 Size (acres): 5

Location:  
KELSEY CREEK. CA. 6 AIR MILES SOUTHEAST OF YAAK. FOLLOW COUNTY ROUTE  
68 FROM YAAK SOUTH CA. 7 MILES TO FS RD 6065. GO UP 6065 CA. 1.5 MILES  
TO CROSSING WITH KELSEY CREEK TRIBUTARY. POPULATION IS ABOVE ROAD ON  
BOTH SIDES OF THICKET OPENING.

Element occurrence data:  
1996: 50-100 ROBUST PLANTS. 1995: 50-100 PLANTS, 2 SUBPOPULATIONS,  
100% WITH NEARLY MATURE SPOROPHORES.

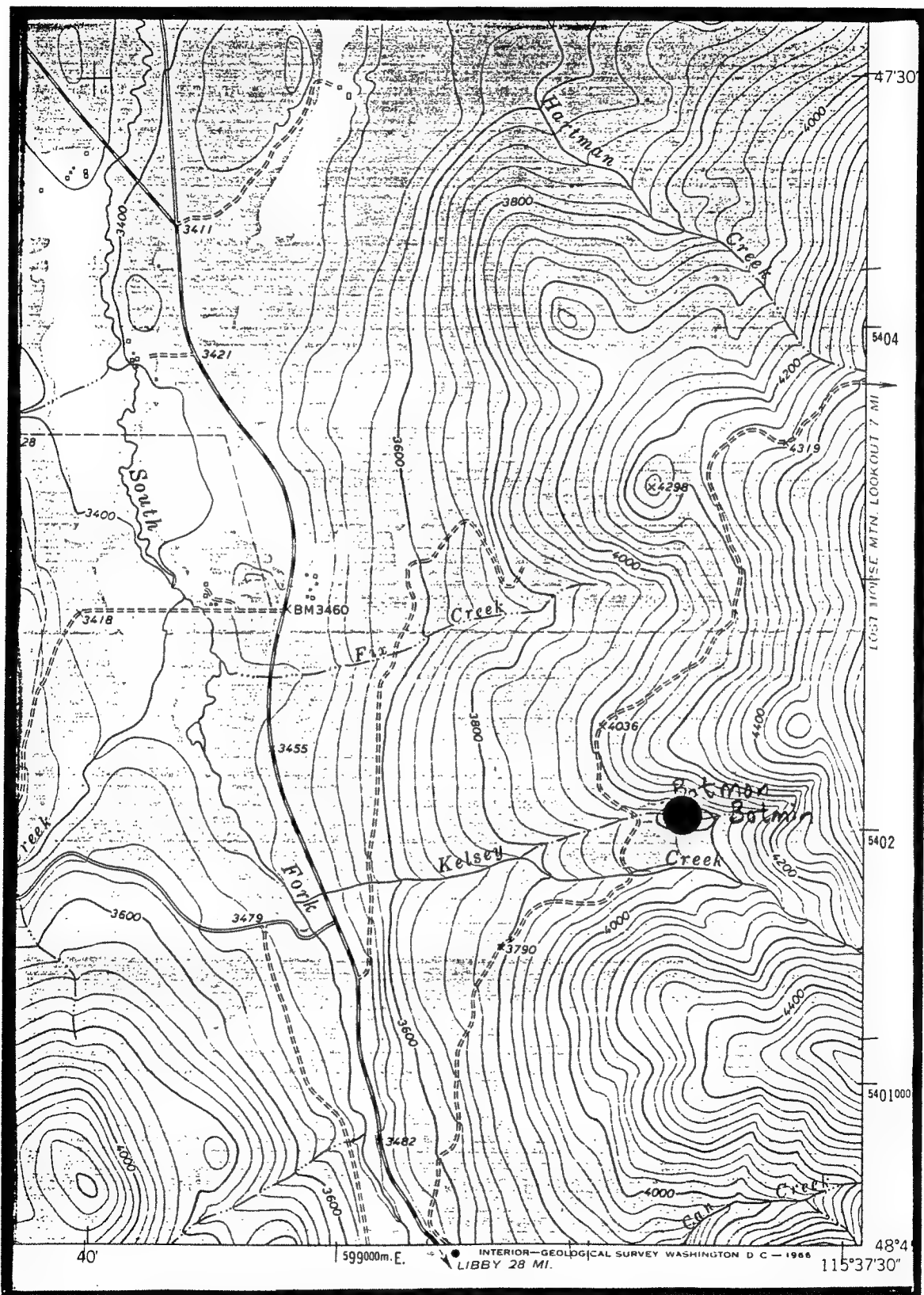
General site description:  
MOIST, SHADED, GLACIATED MOUNTAIN SLOPE DRAW BOTTOM. LANDTYPE 352.  
GLACIAL TILL AND ALLUVIAL PARENT MATERIAL, ORGANIC SOIL. ASSOCIATED  
SPECIES: THUJA PLICATA, LINNAEA BOREALIS, TIARELLA TRIFOLIATA, ABIES  
LASIOCARPA, CLINTONIA UNIFLORA, GALIUM TRIFLORUM, TRILLIUM OVATA,  
MITELLA NUDA, GOODYERA OBLONGIFOLIA, DISPORUM HOOKERI, OSMORHIZA  
CHILENSIS, MONESES UNIFLORA, BOTRYCHIUM MONTANUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
1996: SURVEYED BY J. VANDERHORST; ECODATA PLOT FS01140496JV001. 1995:  
SURVEYED BY M. ARVIDSON AND J. VANDERHORST. PART OF POPULATION AREA IS  
DESIGNATED BOTANICAL SPECIAL INTEREST AREA ON S.O. MANAGEMENT AREA  
MAP. PHOTOCOPY OF SPECIMEN DETERMINED BY P. ZIKA. PLANTS COLLECTED BY  
L. SWARTZ (U OF ID) FOR MORPHOLOGICAL AND DNA ANALYSIS IN 1996.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5538). 1995. MONTU.



*Botrychium manganense*; Kelsey Creek (025)  
USGS Yaak 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.026  
Element occurrence type:

Survey site name: PIPE CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: GOLD HILL

Township: Range: Section: TRS comments:  
032N 031W 8 N2SE4; 9 W2

Precision: S  
Survey date: Elevation: 4240 -  
First observation: 1995-08-23 Slope/aspect: LEVEL  
Last observation: 1996-08-20 Size (acres): 10

Location:  
PURCELL MOUNTAINS, ON TRIBUTARY OF PIPE CREEK, CA. 11 AIR MILES NORTH  
OF LIBBY. ACCESS VIA PIPE CREEK ROAD (COUNTY ROUTH 68).

Element occurrence data:  
JULY, 1996: 2 ADDITIONAL SUBPOPULATIONS FOUND IN SECTION 9; CA. 20  
PLANTS TOTAL. AUGUST, 1996: 3 SUBPOPULATIONS; NORTHERNMOST INCLUDES 21  
PLANTS, 100% WITH MATURE SPORES. 1995: <20 PLANTS, 100% WITH MATURING  
SPOROPHORES.

General site description:  
MOIST, PARTIAL TO HEAVY SHADE, GLACIATED MOUNTAIN STREAM VALLEY BOTTOM  
UNDER CEDAR CANOPY AND IN UNUSUAL WETLAND THICKET HABITAT. LANDTYPE  
329. ASSOCIATED SPECIES: THUJA PLICATA, CLINTONIA UNIFLORA, ALNUS  
SINUATA, OPILOPANAX HORRIDUM, PSEUDOSTUGA MENZIESII, VACCINIUM  
MEMBRANACEUM, ATHYRIUM FELIX-FEMINA, DISPORUM HOOKERI, LISTERA  
CAURINA, ADENOCAULON BICOLOR, ACER GLABRUM, BOTRYCHIUM VIRGINIANUM,  
ORTHILLA SECUNDA, SMILACINA STELLATA. ADDITIONAL SPECIES NOTED IN  
NORTHERN SUBPOPULATION: CAREX BRUNNESCENS, EQUISETUM HYEMALE, GLYCERIA  
SPP., LINNAEA BOREALIS.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST, J. RENY, AND T. BIELAK. PHOTOCOPY OF  
SPECIMEN DETERMINED B. MINGANENSE BY P. ZIKA. ECODATA PLOT  
FS01140596JV005.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5547). 1995. MONTU.



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4      Forest Service status: SENSITIVE  
State rank: S2S3      Federal Status:

Element occurrence code: PPOPH010R0.027  
Element occurrence type:

Survey site name: CEDAR CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: SCENERY MOUNTAIN

Township: Range: Section: TRS comments:  
031N      032W      34      NW4

Precision: S  
Survey date:      Elevation: 3480 - 3520  
First observation: 1995-08-04      Slope/aspect: LEVEL  
Last observation: 1996-08-04      Size (acres): 1

Location:  
CEDAR CREEK, CA. 5.5 AIR MILES WEST OF LIBBY. FROM HWY 2, DRIVE UP  
CEDAR CREEK ON FS RD 402 TO TRAILHEAD. POPULATION IS UP TRAIL CA. 1  
MILE ON LEVEL BENCH BETWEEN THE TRAIL AND CREEK.

Element occurrence data:  
1996: 10 PLANTS. 1995: 18 PLANTS, 100% WITH IMMATURE SPOROPHORES.

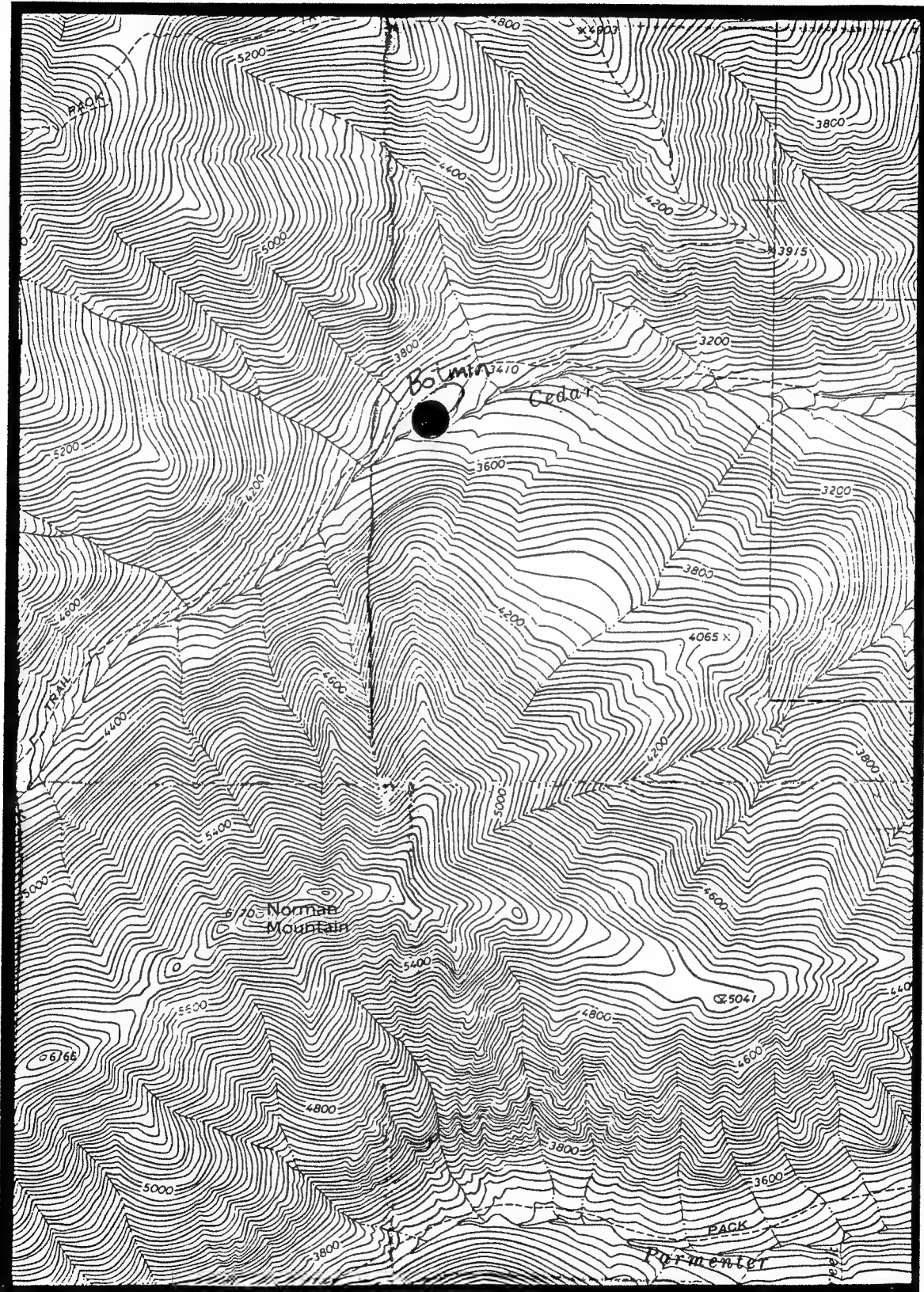
General site description:  
MOIST, SHADED SWALE BOTTOM ON GLACIATED VALLEY BENCH. LANDTYPE 407.  
GLACIAL TILL PARENT MATERIAL, ORGANIC HUMUS/DUFF SOIL. ASSOCIATED  
SPECIES: THUJA PLICATA, PSEUDOTSUGA MENZIESII, ABIES GRANDIS,  
CLINTONIA UNIFLORA, ADENOCALON BICOLOR, SMILACINA STELLATA, TIARELLA  
TRIFOLIATA, GYMNOCARPIUM DRYOPTERIS, BOTRYCHIUM MONTANUM, VIOLA SP.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
SURVEYED BY J. VANDERHORST. DISTURBANCE EVIDENCED BY OLD SAWED STUMP  
WITH FIRE SCAR. PHOTOCOPY OF SPECIMEN DETERMINED B. MINGANENSE BY P.  
ZIKA. ECODATA PLOT FS01140596JV011.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5511). 1995. MONTU.



Botrychium minganense; Cedar Creek (027)  
USGS Scenery Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.028  
Element occurrence type:

Survey site name: ZULU CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: PINK MOUNTAIN

Township: Range: Section: TRS comments:  
034N 031W 10 SW4

Precision: S  
Survey date: Elevation: 4640 -  
First observation: 1992 Slope/aspect: 0-5% / -  
Last observation: 1996-09-03 Size (acres): 10

Location:

ZULU CREEK, CA. 9 AIR MILES SOUTHWEST OF YAAK. FROM FS RD 68, DRIVE UP  
FS RD 6079 CA. 3 MILES, TURN RIGHT ON SPUR ROAD, AND FOLLOW CA. 2  
MILES TO THIRD TRIBUTARY CROSSING. PLANTS ARE IN CREEK BOTTOM ABOVE  
ROAD AND CLEARCUTS.

Element occurrence data:

1996: FEWER PLANTS THAN 1995, EST. 50. 1 SEPTEMBER 1995: CA. 200  
BOTRYCHIUM MINGANENSE PLANTS IN GENUS COMMUNITY, 100% WITH MATURE  
DISPERSING SPORES. 9 AUGUST 1995: 100% IMMATURE SPOROPHORES.

General site description:

MOIST TO SATURATED, MOSSY, SHADED, GLACIATED VALLEY BOTTOM. LANDTYPE  
357. ALLUVIUM PARENT MATERIAL, ORGANIC DUFF SOIL. THUJA  
PLICATA/CLINTONIA UNIFLORA HABITAT TYPE. ASSOCIATED SPECIES: TIARELLA  
TRIFOLIATA, PICEA ENGELMANII, VERONICA AMERICANA, HABENARIA SACCATA,  
ACTAEA RUBRA, PSEUDOTSUGA MENZIESII, LARIX OCCIDENTALIS, ORTHILLA  
SECUNDA, MONESUS UNIFLORA, BOTRYCHIUM PARADOXUM, B. MINGANENSE, B.  
VIRGINIANUM, AND B. PINNATUM.

Land owner/manager:

KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

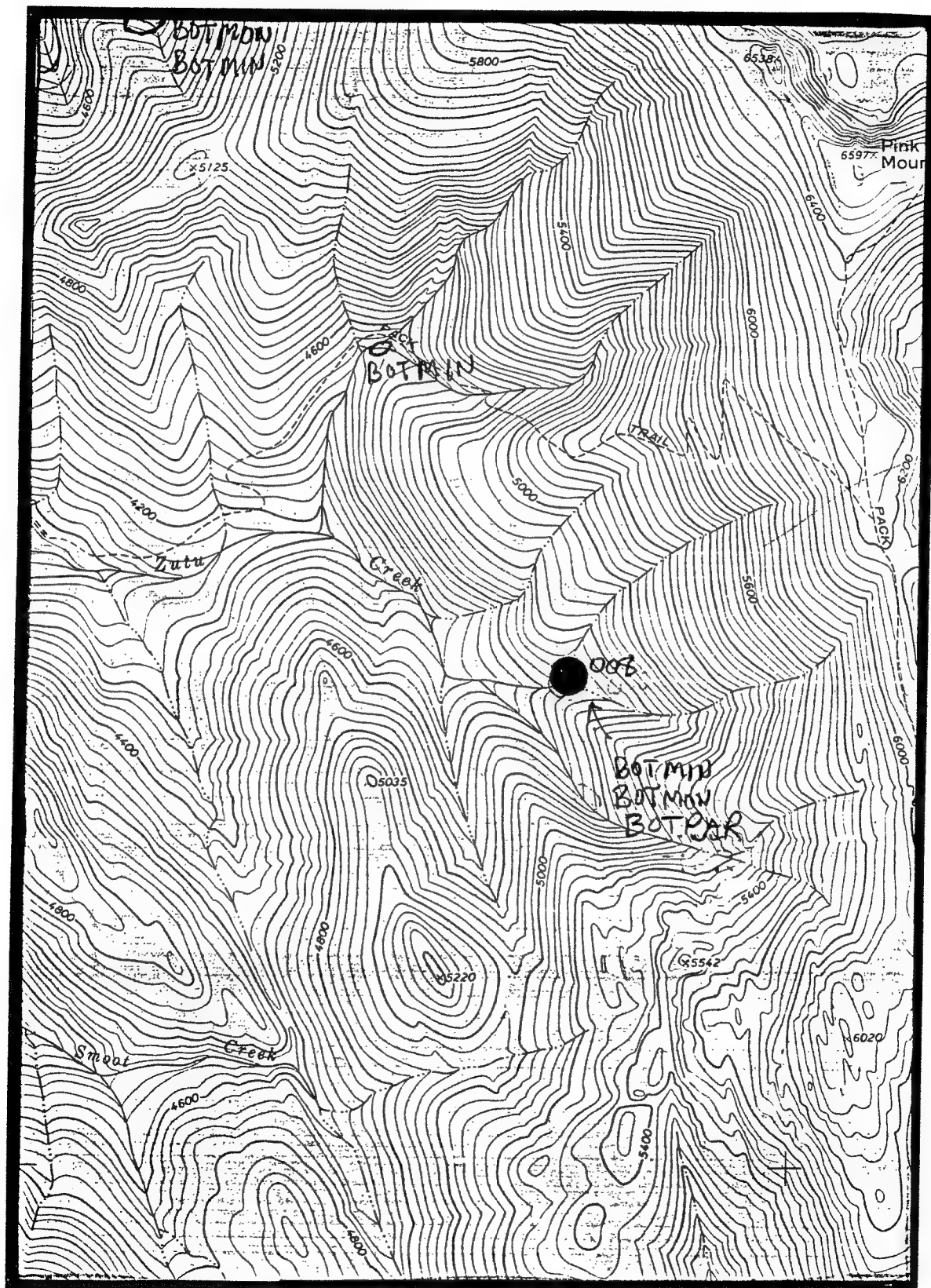
Comments:

OBSERVED BY J. VANDERHORST, M. ARVIDSON, AND L. SEDLER. DISTURBANCE BY  
LARGE WINDFALL, LEAVING POOLS OF SURFACE WATER. SITE WAS SAMPLED FOR  
PLANT COMPOSITION USING REPLICATED MICROPLOTS. PHOTOCOPY OF SPECIMENS  
DETERMINED B. MINGANENSE BY P. ZIKA. ECODATA PLOT #FS01140395JV008.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5518). 1995. MONTU.





Botrychium minagnense; Zulu Creek (028)  
USGS Pink Mountain 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.029  
Element occurrence type:

Survey site name: PURCELL RIDGE  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: PINK MOUNTAIN

Township: Range: Section: TRS comments:  
034N 031W 26 SW4

Precision: S  
Survey date: Elevation: 4920 -  
First observation: 1994 Slope/aspect: 5% / SOUTH  
Last observation: 1995-08-22 Size (acres):

Location:

PURCELL MOUNTAINS. CA. 20 AIR MILES NORTH OF LIBBY. FROM LIBBY, TRAVEL  
NORTH UP PIPE CREEK ROAD (COUNTY ROUTE 68) TO THE EAST FORK OF PIPE  
CREEK ROAD (FS RD 336). TAKE RD 336 THEN RD 112 THEN RD 112L TO RD  
14467. FOLLOW THIS TO ITS END. PLANT IS IN DRAW ABOVE CLEARCUT.

Element occurrence data:  
1 PLANT, IMMATURE SPORANGIA.

General site description:

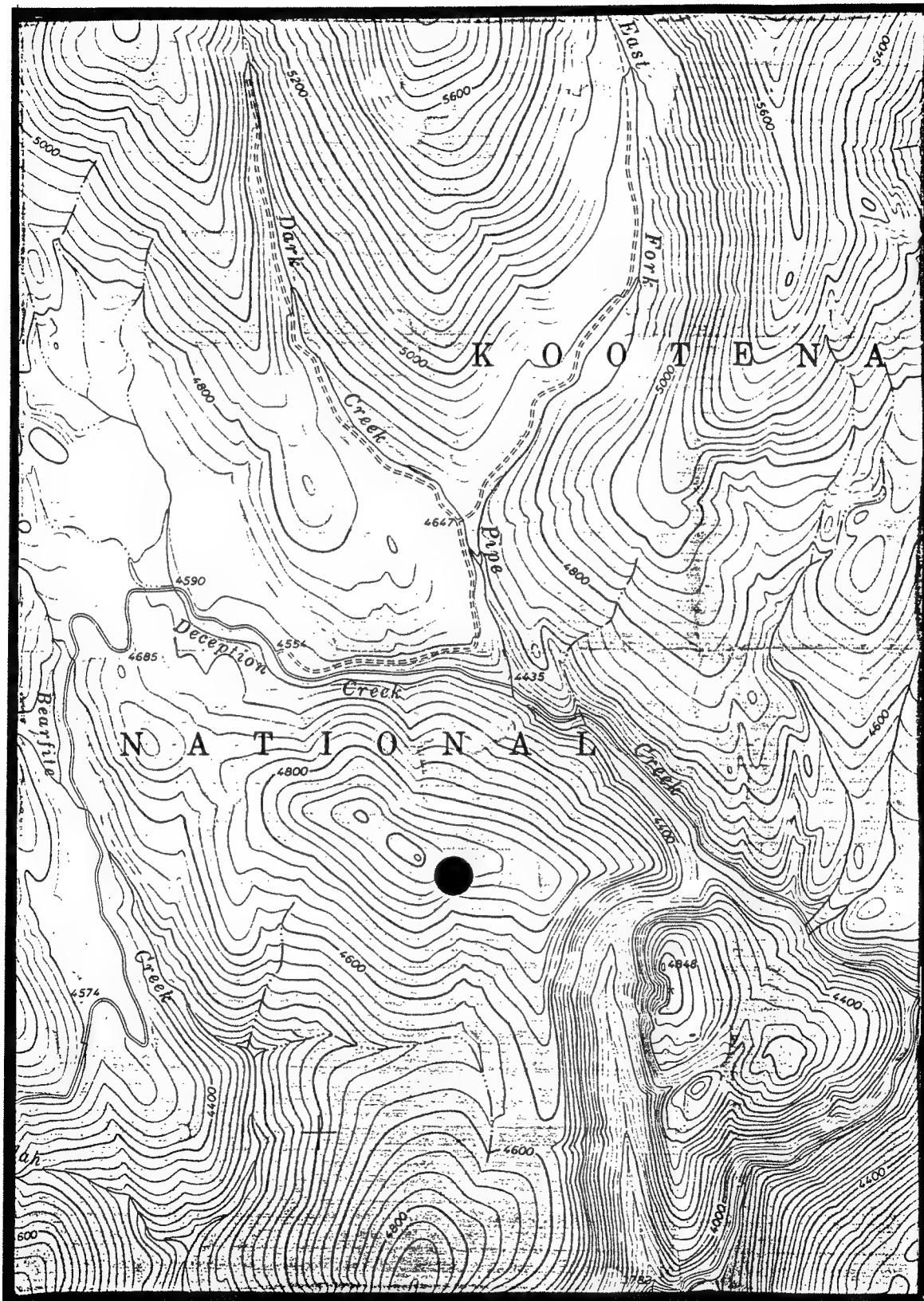
MOIST, PARTIALLY-SHADED GLACIATED MOUNTAIN SLOPE CREST. LANDTYPE 355.  
GLACIAL TILL AND BELT SERIES SEDIMENTARY PARENT MATERIAL, DUFF/HUMUS  
SOIL. ASSOCIATED SPECIES: PICEA ENGELMANII, LARIX OCCIDENTALIS, THUJA  
PLICATA, VACCINIUM MEMBRANACEUM, ARNICA CORDIFOLIA, GALIUM TRIFLORUM,  
TIARELLA TRIFOLIATA, GOODYERA OBLONGIFOLIA, BROMUS INERMIS, CLINTONIA  
UNIFLORA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST AND M. LOLLY. DISTURBANCE BY LOGGING,  
BLOWDOWN, AND GAME TRAILS. HABITAT IS ATYPICAL, AND ADJACENT HABITAT  
IS HIGHLY DISTURBED.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



Botrychium minganense; Purcell Ridge (029)  
USGS Pink Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.030  
Element occurrence type:

Survey site name: UPPER CAN CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: PINK MOUNTAIN

Township: Range: Section: TRS comments:  
035N 031W 33 SW4 (UNSURVEYED SECTION)

Precision: S  
Survey date: Elevation: 4600 -  
First observation: 1995-08-01 Slope/aspect: LEVEL  
Last observation: 1995-08-01 Size (acres): 3

Location:  
UPPER CAN CREEK. CA. 7 AIR MILES SSE OF YAAK, AT HEAD OF CAN CREEK.  
ACCESS VIA GATED SPUR ROAD FROM ZULU CREEK ROAD (FS RD 6079).

Element occurrence data:  
CA. 100 PLANTS, 100% WITH IMMATURE SPOROPHORES.

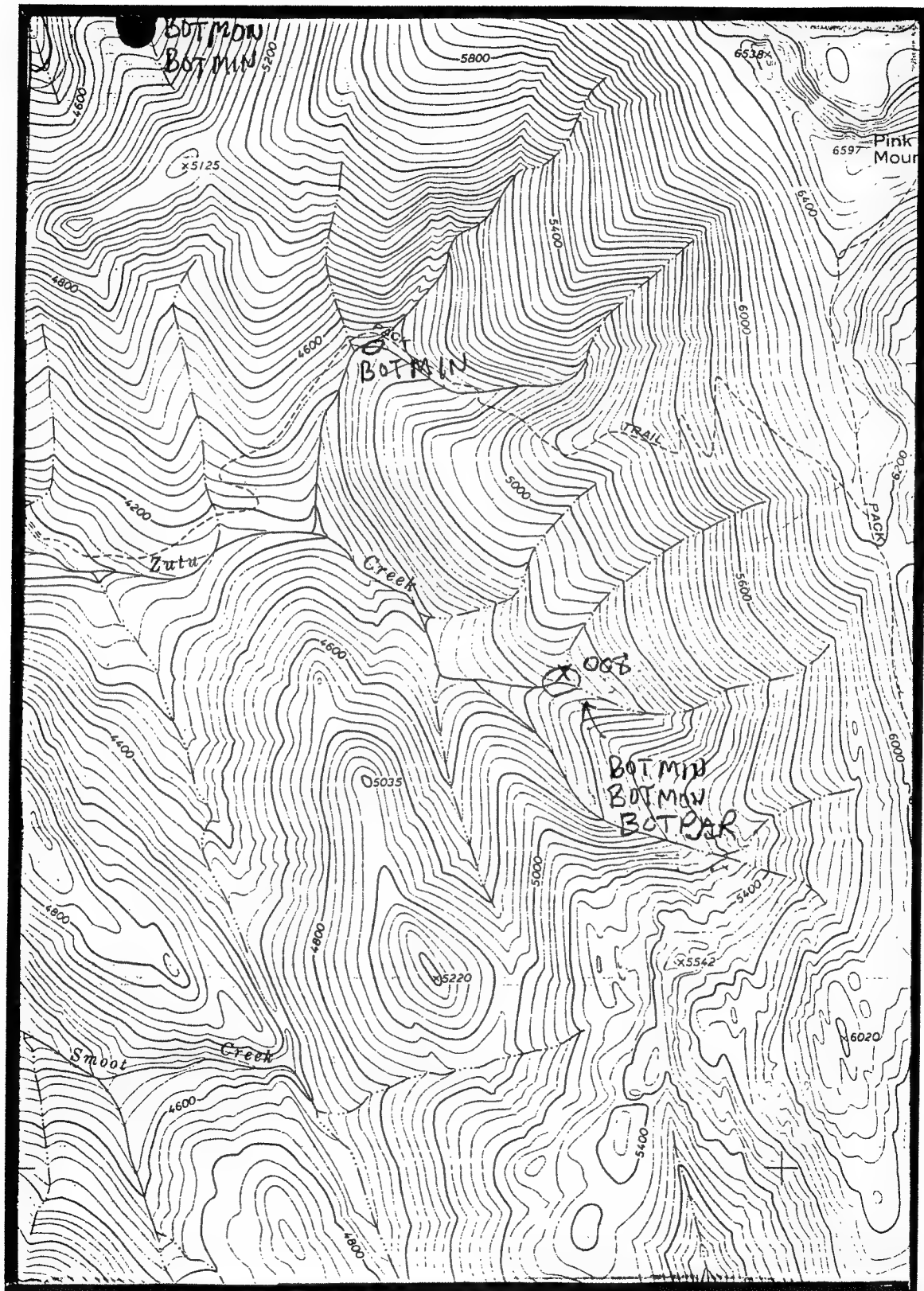
General site description:  
MOIST, SHADY WITH SUNSPOTS. SWALES ON LEVEL BENCH OF GLACIATED  
MOUNTAIN MIDSLOPE. ASSOCIATED SPECIES: THUJA PLICATA, CLINTONIA  
UNIFLORA, LARIX OCCIDENTALIS, GOODYERA OBLONGIFOLIA, ASTER SP.,  
LISTERA SP., BOTRYCHIUM MONTANUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
PHOTOCOPY OF SPECIMEN DETERMINED B. MINGANENSE BY P. ZIKA.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5509). 1995. MONTU.



Botrychium manganense; Upper Can Creek (030)  
USGS Pink Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.031  
Element occurrence type:

Survey site name: ZULU CREEK PACK TRAIL  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: PINK MOUNTAIN

Township: Range: Section: TRS comments:  
034N 031W 4 SE4 (UNSURVEYED SECTION)

Precision: S  
Survey date: Elevation: 4520 -  
First observation: 1995-08-03 Slope/aspect: LEVEL  
Last observation: 1995-08-03 Size (acres): 1

Location:  
ZULU CREEK PACK TRAIL, CA. 8.5 MILES SOUTHWEST OF YAAK AND 1.3 AIR  
MILE SOUTHWEST OF PINK MOUNTAIN.

Element occurrence data:  
3 PLANTS, ALL IMMATURE.

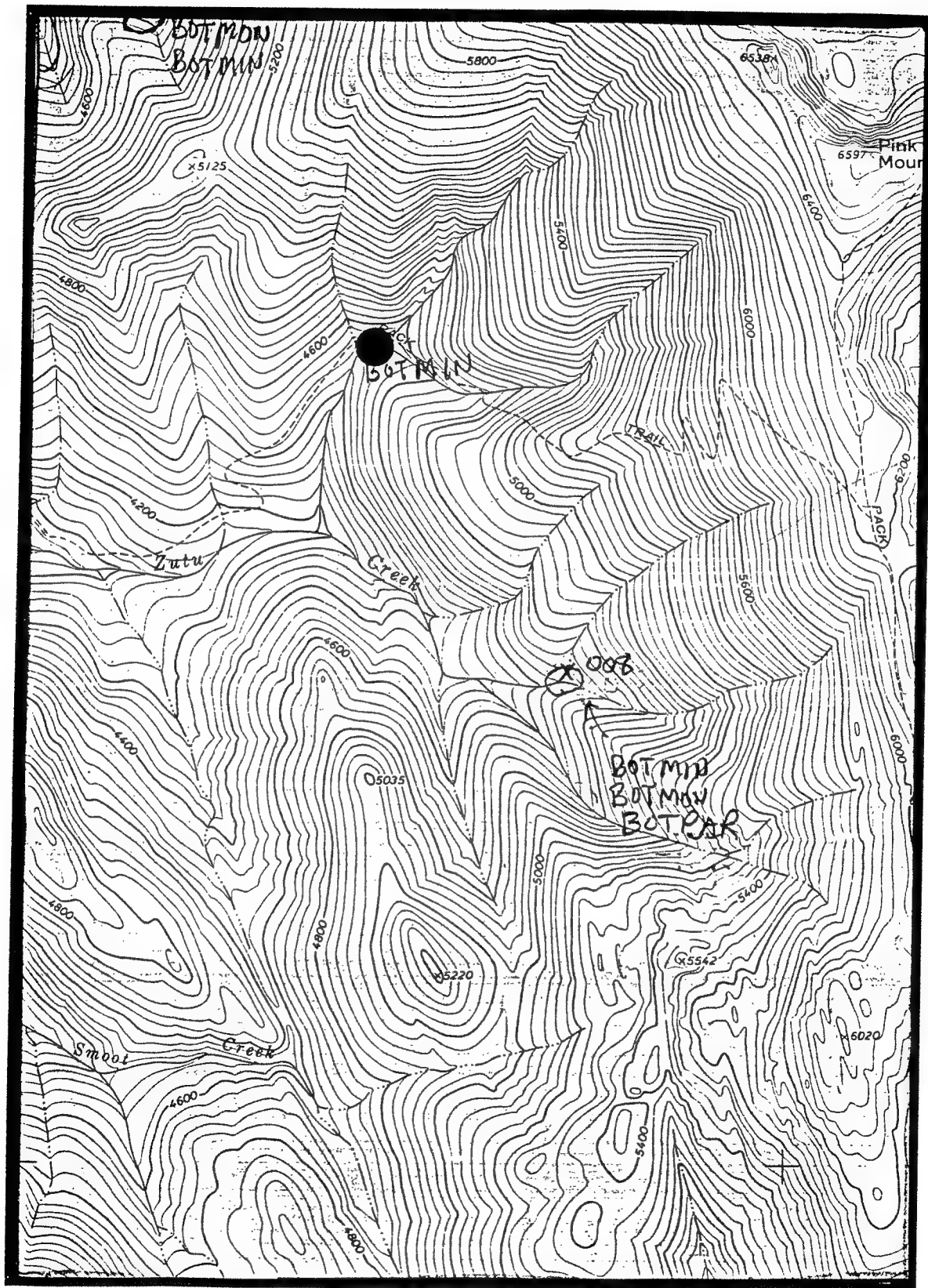
General site description:  
MOIST, SHADED GLACIATED STREAM BOTTOM. LANDTYPE 357. ASSOCIATED  
SPECIES: THUJA PLICATA, LARIX OCCIDENTALIS, CLINTONIA UNIFLORA,  
GYMNOCARPIUM DRYOPTERIS, CHIMAPHILA UMBELLATUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST. PLANTS CONFINED TO PATCH OF OLD GROWTH  
FOREST; COULD NOT BE FOUND IN SURROUNDING YOUNGER FOREST. EVIDENCE OF  
SUSCEPTIBILITY TO FIRE.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



Botrychium minganense; Zulu Creek Pack Trail (031)  
USGS Pink Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.032  
Element occurrence type:

Survey site name: PETE CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: GARVER MOUNTAIN

Township: Range: Section: TRS comments:  
036N 033W 13 NE4 (UNSURVEYED SECTION)

Precision: S  
Survey date: 1996-08-01 Elevation: 3600 -  
First observation: 1993 Slope/aspect: LEVEL  
Last observation: 1995-07-21 Size (acres): 1

Location:

PETE CREEK. FROM YAAK RIVER ROAD (FS RD 92) FOLLOW PETE CREEK ROAD (FS RD 338) 5 MILES NORTH TO JUNCTION WITH FS RD 14125. WALK SOUTH ON 14125 CA. 0.5 MILE TO STREAM CROSSING. PLANTS ARE DOWNSTREAM.

Element occurrence data:

1996: NONE FOUND. 21 JULY 1995: 5 PLANTS COUNTED WITH ADDITIONAL SUBPOPULATIONS REPORTED. 100% WITH IMMATURE SPOROPHORES.

General site description:

MOIST, SHADED GLACIATED VALLEY BOTTOM. LANDTYPE 352. ALLUVIUM PARENT MATERIAL, ORGANIC SOIL. ASSOCIATED SPECIES: TSUGA HETEROPHYLLA, THUJA PLICATA, CLINTONIA UNIFLORA, TIARELLA TRIFOLIATA, LINNAEA BOREALIS, VACCINIUM MEMBRANACEUM, SMILACINA STELLATA, PINUS MONTICOLA, ATHYRIUM FILIX-FEMINA, BOTRYCHIUM LANCEOLATUM.

Land owner/manager:

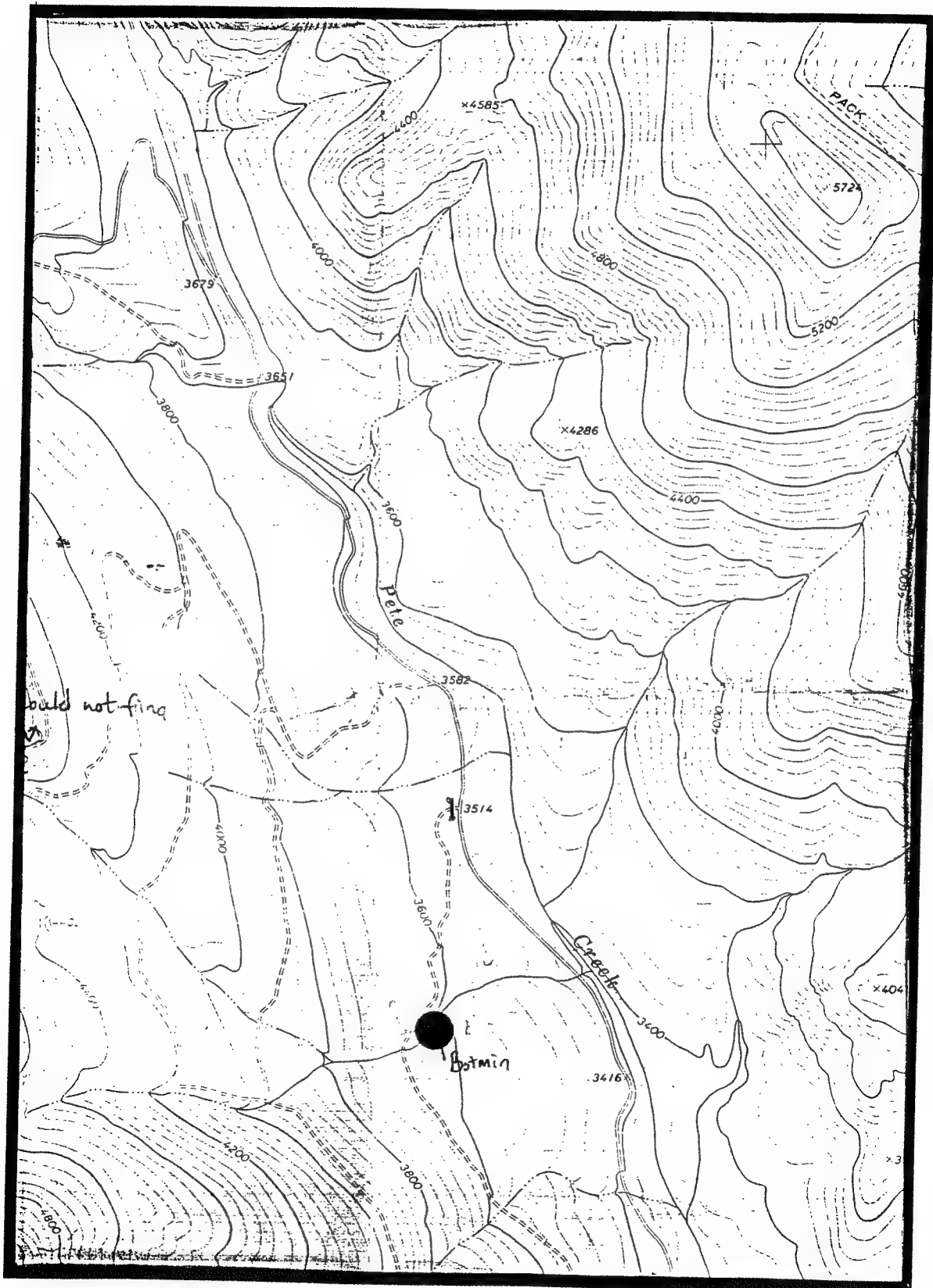
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:

OBSERVED BY J. VANDERHORST IN 1995 AND 1996. ECODATA PLOT FS01140296JV009. ADDITIONAL SUBPOPULATIONS REPORTED BY L. FERGUSON.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY, MT 59935.

Specimens: VANDERHORST, J. (5462). 1995. MONTU.



Botrychium minganense; Pete Creek (032)  
USGS Garver Mountain 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.033  
Element occurrence type:

Survey site name: BEETLE CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: GARVER MOUNTAIN

Township: Range: Section: TRS comments:  
036N 033W 10 NE4; 3 NE4  
037N 033W 36 SE4

Precision: S  
Survey date: Elevation: 4160 - 4600  
First observation: 1995-08-14 Slope/aspect: 0% / NE  
Last observation: 1996-09-26 Size (acres): 1

Location:  
BEETLE CREEK TRIBUTARY. CA. 8 AIR MILES NORTHWEST OF YAAK. FROM YAAK  
RIVER ROAD, TRAVEL NORTH ON PETE CREEK ROAD (FS RD 338) TO JUNCTION  
WITH FS RD 748. FOLLOW 748 CA. 3 MILES TO THIRD STREAM CROSSING.  
PLANTS ARE BELOW ROAD ON WEST SIDE OF CREEK.

Element occurrence data:  
1996: 45 PLANTS WITH SPORES PRESENT. 1995: <50 PLANTS, 100% WITH  
IMMATURE SPORANGIA.

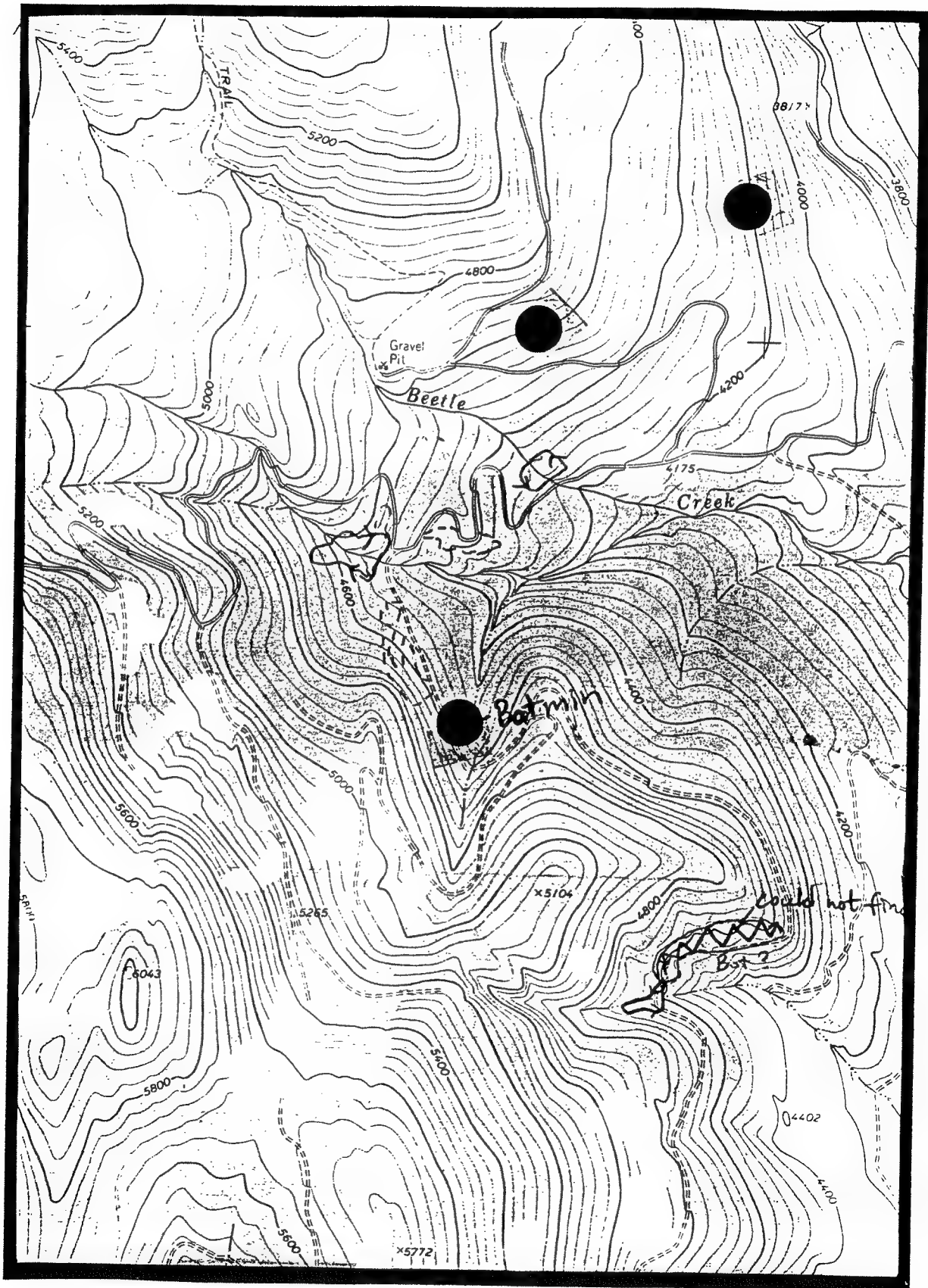
General site description:  
MOIST TO SATURATED, SHADED GLACIATED STREAM VALLEY BOTTOM. LANDTYPE  
108. ALLUVIUM PARENT MATERIAL, SILTY DUFF AND SILT SOIL. ASSOCIATED  
SPECIES: THUJA PLICATA, OPILODENDRON HORRIDUM, GYMNOCARPIUM DRYOPTERIS,  
TIARELLA TRIFOLIATA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY M. ARVIDSON AND L. SEDLER IN 1996; BY J. VANDERHORST IN  
1995.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5526). 1995. MONTU.



*Botrychium minganense*; Beetle Creek (033)  
USGS Garver Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.034  
Element occurrence type:

Survey site name: WEST FISHER CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: BARREN PEAK

Township: Range: Section: TRS comments:  
026N 030W 4 SE4

Precision: S  
Survey date: Elevation: 3240 -  
First observation: 1995-08-01 Slope/aspect: 5% / SOUTH  
Last observation: 1996-07-30 Size (acres):

Location:  
TAKE HWY 2 TO WEST FISHER ROAD (FS RD 231). TAKE FS RD 231 CA. 0.25  
MILE PAST TURN TO LAKE CREEK CAMPGROUND, AND TURN EAST ONTO OLD ROAD.  
FOLLOW OLD ROAD CA. 0.5 MILE UNTIL IT NEARS DRAW WITH WATER. SITE IS  
CA. 150 FEET BELOW SECTION LINE/STREAM INTERSECTION.

Element occurrence data:  
1996: ONE PLANT ON MOSSY LOG; OTHERS PRESUMED EXTIRPATED BY SPRING  
FLOODS. 1995: 4 PLANTS, 100% WITH SPORES, OBSERVED ON 1 AUG 1995 AND 1  
PLANT OBSERVED ON 25 AUG 1995.

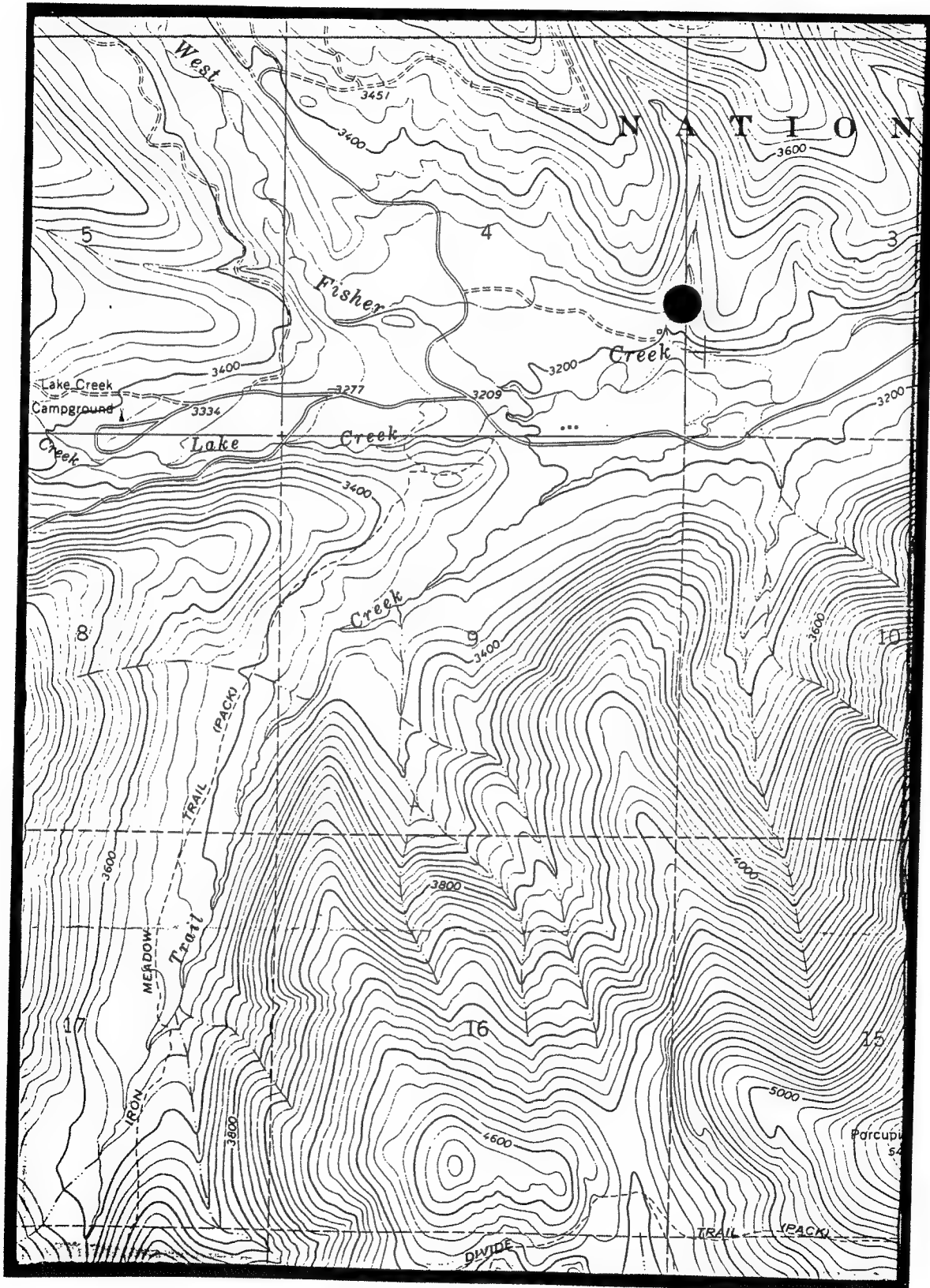
General site description:  
WET TO SATURATED BOTTOM NEAR STREAM. ASSOCIATED SPECIES: ALNUS  
SINUATA, SYMPHORICARPOS ALBUS, VIOLA GLABELLA, GALIUM TRIFIDUM,  
ANGELICA ARGUTA, MENTHA ARVENSIS, THALICTRUM OCCIDENTALE, CORNUS  
CANADENSIS, ROSA GYMNOCARPA, CORNUS STOLONIFERA, EQUISETUM ARVENSE,  
RIBES LACUSTRE, SMILACINA STELLATA, CIRCAEA ALPINA, GEUM MACROPHYLLUM,  
BOTRYCHIUM VIRGINIANUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
1996: OBSERVED BY J. RENY, T. BIELAK, J. ELLIOTT AND J. VANDERHORST;  
ECODATA PLOT FS01140596JV008 (AFTER THE FLOOD). 1995: OBSERVED BY J.  
RENY AND T. BIELAK. DISTURBANCE BY IRON PIPE DOWNSTREAM AND SOME GAME  
TRAILS. ROAD RECONSTRUCTION PROPOSED CA. 78 FEET DOWNSTREAM FROM  
POPULATION.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:



Botrychium minganense; West Fisher Creek (034)  
USGS Barren Peak 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.035  
Element occurrence type:

Survey site name: WARLAND CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: CRIPPLE HORSE MOUNTAIN

Township: Range: Section: TRS comments:  
032N 028W 35 NE4

Precision: S  
Survey date: 1996-08-07 Elevation: 4120 -  
First observation: 1994-07-12 Slope/aspect:  
Last observation: 1995-07-12 Size (acres): 1

Location:  
UPPER WARLAND CREEK. FROM HWY 37 ON EAST SIDE OF LAKE KOOCANUSA,  
FOLLOW FS RD 566 TO FS RD 4891. FOLLOW 4891 TO FS RD 4891D, THEN TAKE  
4891D TO CROSSING OF WARLAND CREEK. SITE IS DOWNSTREAM.

Element occurrence data:  
1996: NO PLANTS FOUND. 12 JULY 1995: 2 PLANTS.

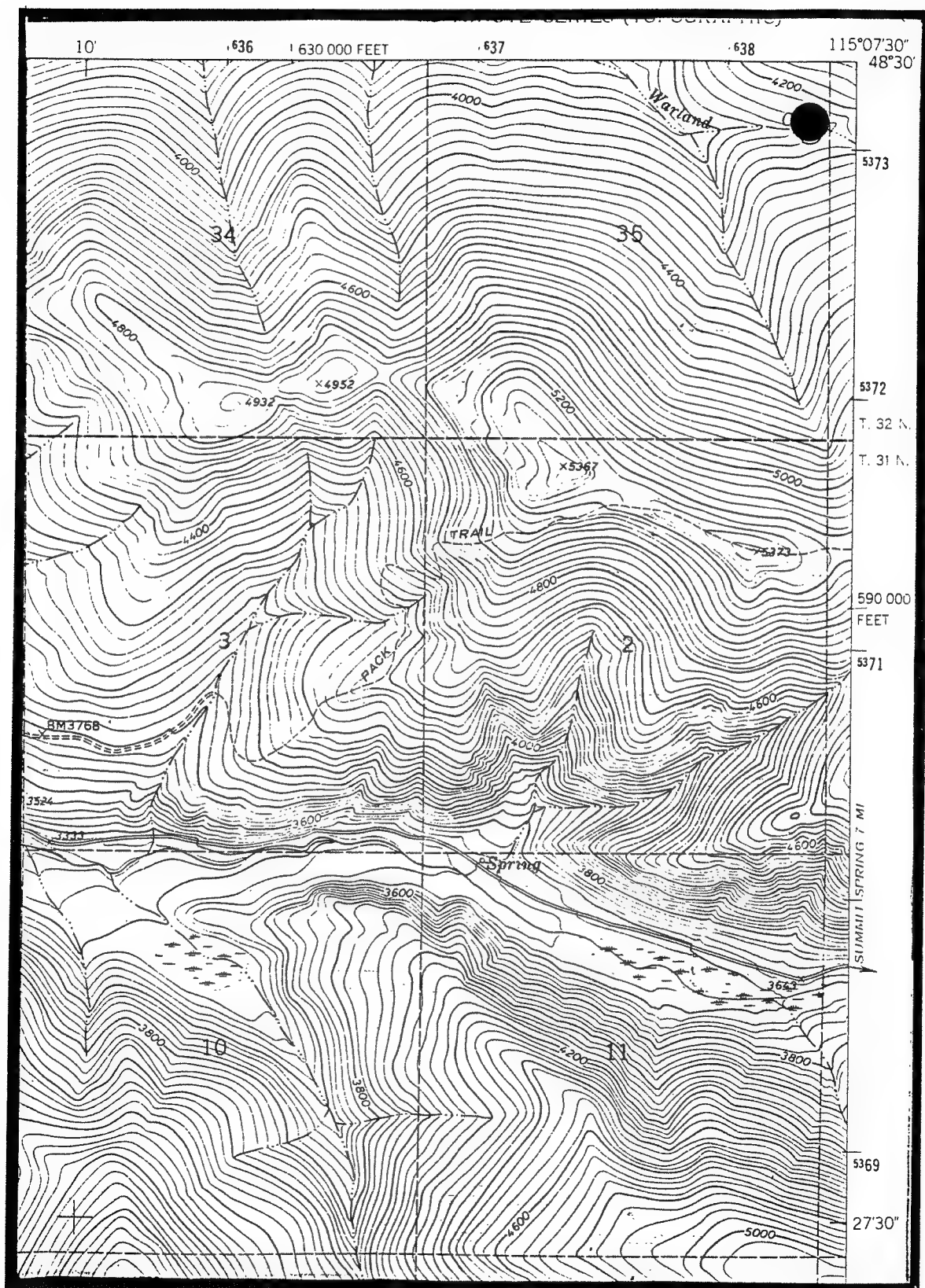
General site description:  
MOIST, PARTIALLY SHADED CREEK BOTTOM. LANDTYPE 352. ASSOCIATED  
SPECIES: ALNUS SINUATA, ATHYRIUM FELIX-FEMINA, OPLOPANAX HORRIDUM,  
GYMNOCARPIUM DRYOPTERIS, CLINTONIA UNIFLORA, TRILLIUM OVATUM, VIOLA  
ORBICULATA, SYMPHORICARPOS ALBUS.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FISHER RIVER RANGER DISTRICT

Comments:  
1996: AREA SURVEYED BY J. VANDERHORST; NO PLANTS FOUND. 1995: OBSERVED  
BY J. RENY AND T. BIELAK. SITE VISITED ONLY ONCE; NO VOUCHER TAKEN.  
IDENTIFICATION OF PLANTS AS B. MINGANENSE TENATIVE.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:



Botrychium minganense; Warland Creek (035)  
USGS Cripple Horse Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.036  
Element occurrence type:

Survey site name: EAST FORK PIPE CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: GOLD HILL

Township: Range: Section: TRS comments:  
033N 031W 15 SW4

Precision: S  
Survey date: Elevation: 3280 -  
First observation: 1995-08-03 Slope/aspect: 0-5% / SW  
Last observation: 1995-08-03 Size (acres): 1

Location:  
EAST FORK PIPE CREEK, CA. 1.7 AIR MILES NORTH OF TOM POOLE LAKE. TAKE  
PIPE CREEK ROAD (COUNTY RT. 68) TO EAST FORK PIPE CREEK ROAD (RT.  
336). GO 1.2 MILES UP 336. SITE NEAR CREEK, CA. 20-40 FEET FROM  
RUNNING WATER.

Element occurrence data:  
6 PLANTS, ALL WITH SPORES.

General site description:  
WET TO SATURATED, PARTIALLY OPEN FLOODPLAIN BOTTOM. LANDTYPE 355.  
ASSOCIATED SPECIES: ALNUS SINUTATA, CORNUS STOLONIFERA, OPLOPANAX  
HORRIDUM, RUBUS PARVIFLORUS, VIOLA GLABELLA, CIRCAEA ALPINA, GALIUM  
TRIFIDUM, STREPTOPUS AMPLEXIFOLUS, GYMNOCARPIUM DRYOPTERIS, LONICERA  
INVOLUCRATA, SYMPHORICARPOS ALBUS, SMILACINA STELLATA, CLINTONIA  
UNIFLORA, SENECIO TRIANGULARIS, THALICTRUM OCCIDENTALE, ACONITUM  
COLUMBINANUM, TRILLIUM OVATUM, RIBES LACUSTRE, EQUISETUM SP.,  
BOTRYCHIUM VIRGINIANUM.

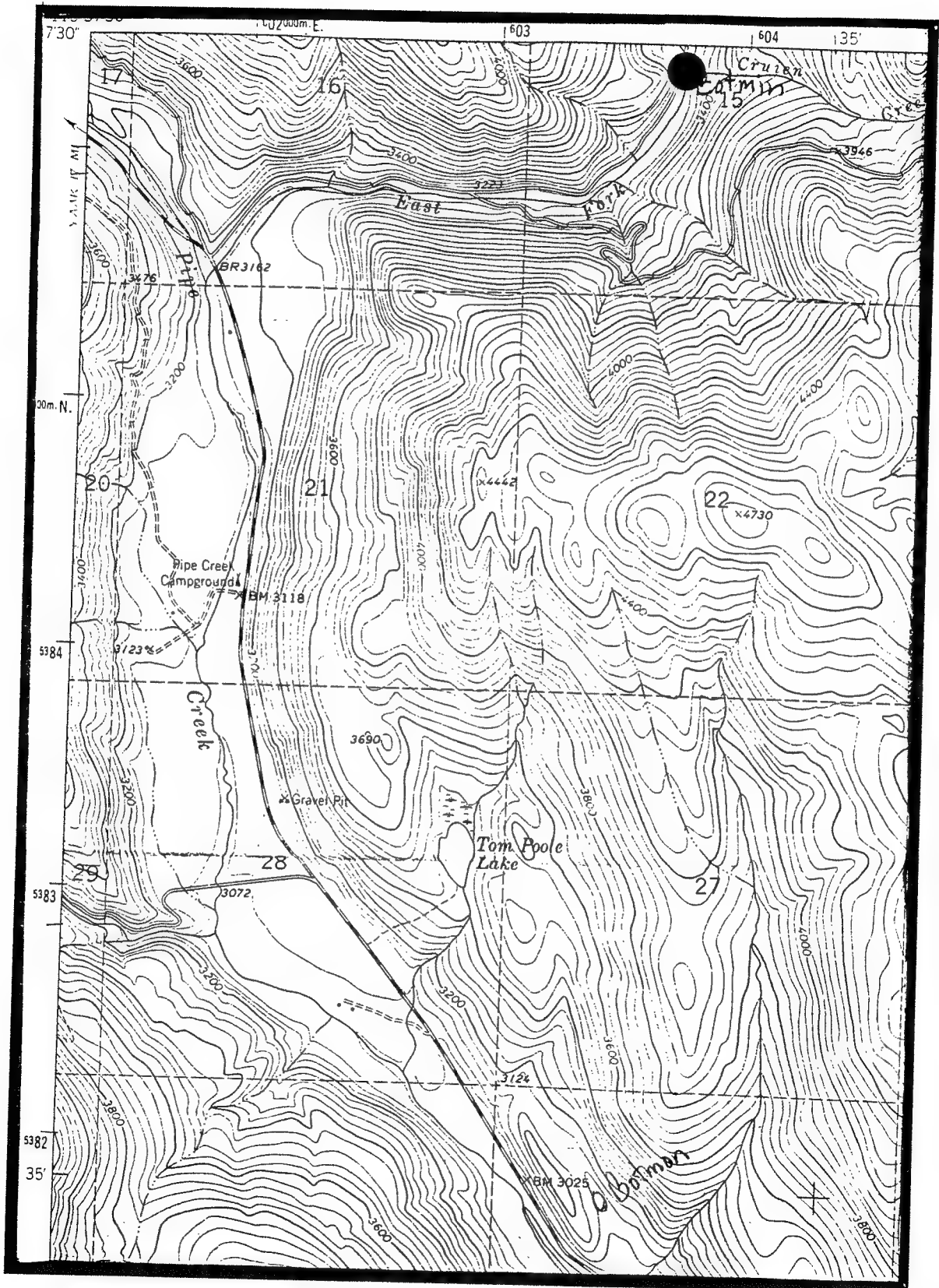
Land owner/manager:  
CORPORATE TIMBERLANDS

Comments:  
OBSERVED BY J. RENY, T. BIELAK, AND J. VANDERHORST. PHOTOCOPY  
DETERMINED BY P. ZIKA.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5545). 1995. MONTU.





Botrychium manganense; East Fork Pipe Creek (036)  
USGS Gold Hill 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.037  
Element occurrence type:

Survey site name: HEMLOCK CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: FLATIRON MOUNTAIN

Township: Range: Section: TRS comments:  
033N 032W 16 NE4 (UNSURVEYED SECTION)

Precision: S  
Survey date: Elevation: 3760 -  
First observation: 1995-08-15 Slope/aspect: LEVEL  
Last observation: 1995-08-15 Size (acres): 1

Location:  
PURCELL MOUNTAINS. HEMLOCK CREEK, CA. 1 MILE ABOVE CONFLUENCE WITH  
SEVENTEENMILE CREEK.

Element occurrence data:  
FEWER THAN 20 PLANTS, 100% WITH IMMATURE SPOROPHORES.

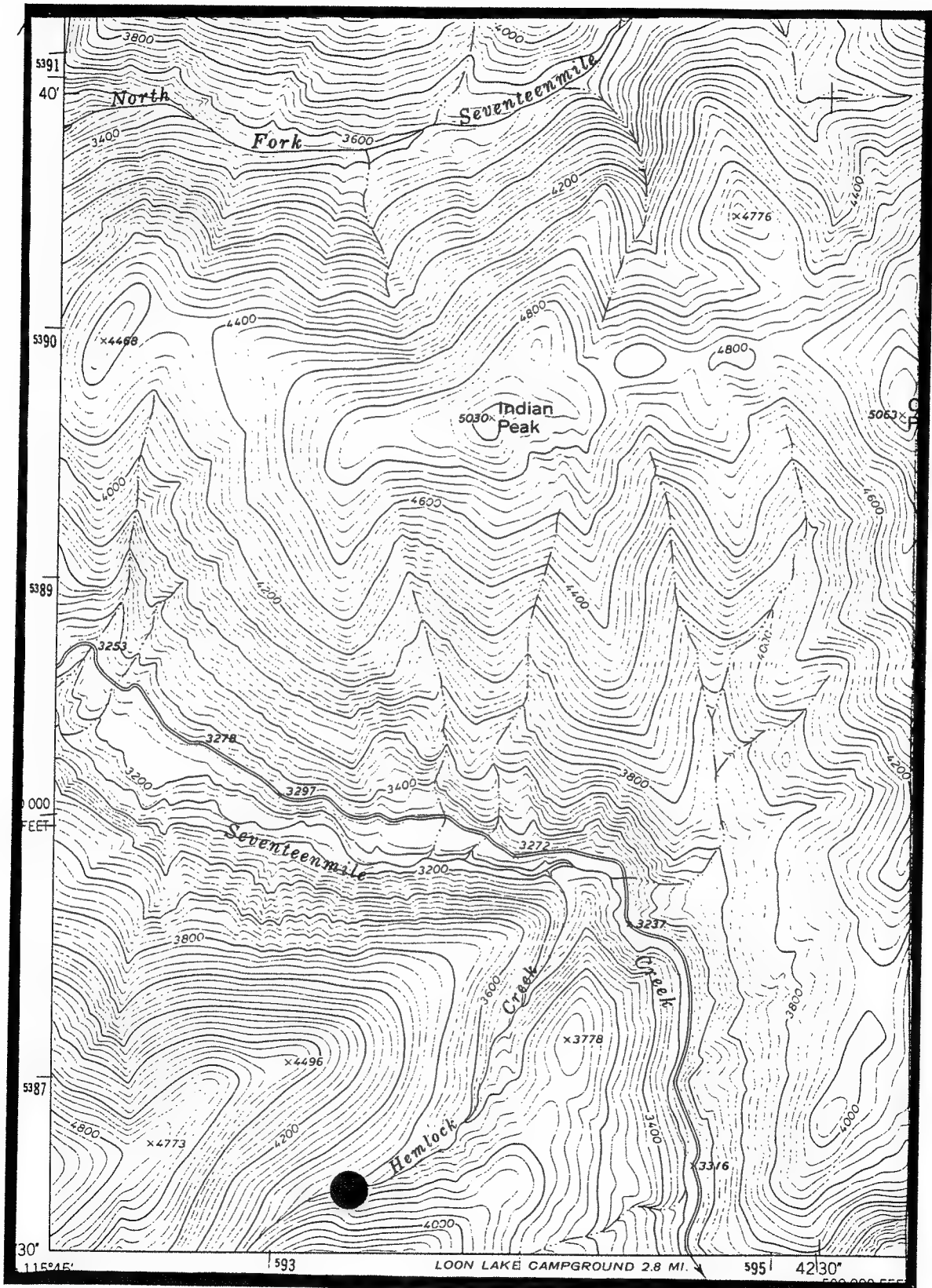
General site description:  
SHADED BOTTOM OF ALLUVIAL FLOODPLAIN OF GLACIATED MOUNTAIN STREAM.  
ALLUVIUM PARENT MATERIAL, SILTY ORGANIC SOIL. LANDTYPE 352. ASSOCIATED  
SPECIES: THUJA PLICATA, OPLOPANAX HORRIDUM, PICEA ENGELMANNII,  
ATHYRIUM FILIX-FEMINA, GYMNOCARPIUM DRYOPTERIS, TIARELLA TRIFOLIATA,  
CLINTONIA UNIFLORA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST. PLANTS CONFINED TO SMALL AREA ALONG TINY  
RIVULET WITH REMNANT OLD GROWTH CEDAR, WHICH ESCAPED PAST FIRES.  
PHOTOCOPY OF SPECIMEN DETERMINED BY P. ZIKA.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5528). 1995. MONTU.



Botrychium manganense; Hemlock Creek (037)  
USGS Flatiron Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4      Forest Service status: SENSITIVE  
State rank: S2S3      Federal Status:

Element occurrence code: PPOPH010R0.038  
Element occurrence type:

Survey site name: RED TOP CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: NEWTON MOUNTAIN

Township: Range: Section: TRS comments:  
034N      034W      2      SW4 (UNSURVEYED SECTION)

Precision: S  
Survey date:      Elevation: 4450 - 4600  
First observation: 1993      Slope/aspect: 10-40% / SOUTH  
Last observation: 1995-07-19      Size (acres): 20

Location:  
PURCELL MOUNTAINS. FROM YAAK RIVER ROAD (HWY 508) FOLLOW FS RD 393 CA.  
10 MILES TO CROSSING OF RED TOP CREEK. POPULATION IS UPSTREAM ON  
SOUTHWEST FACING SLOPES ABOVE CREEK, BOTH UPSTREAM AND DOWNSTREAM FROM  
CLEARCUT.

Element occurrence data:  
CA. 150 PLANTS WITH NEARLY MATURE SPORANGIA.

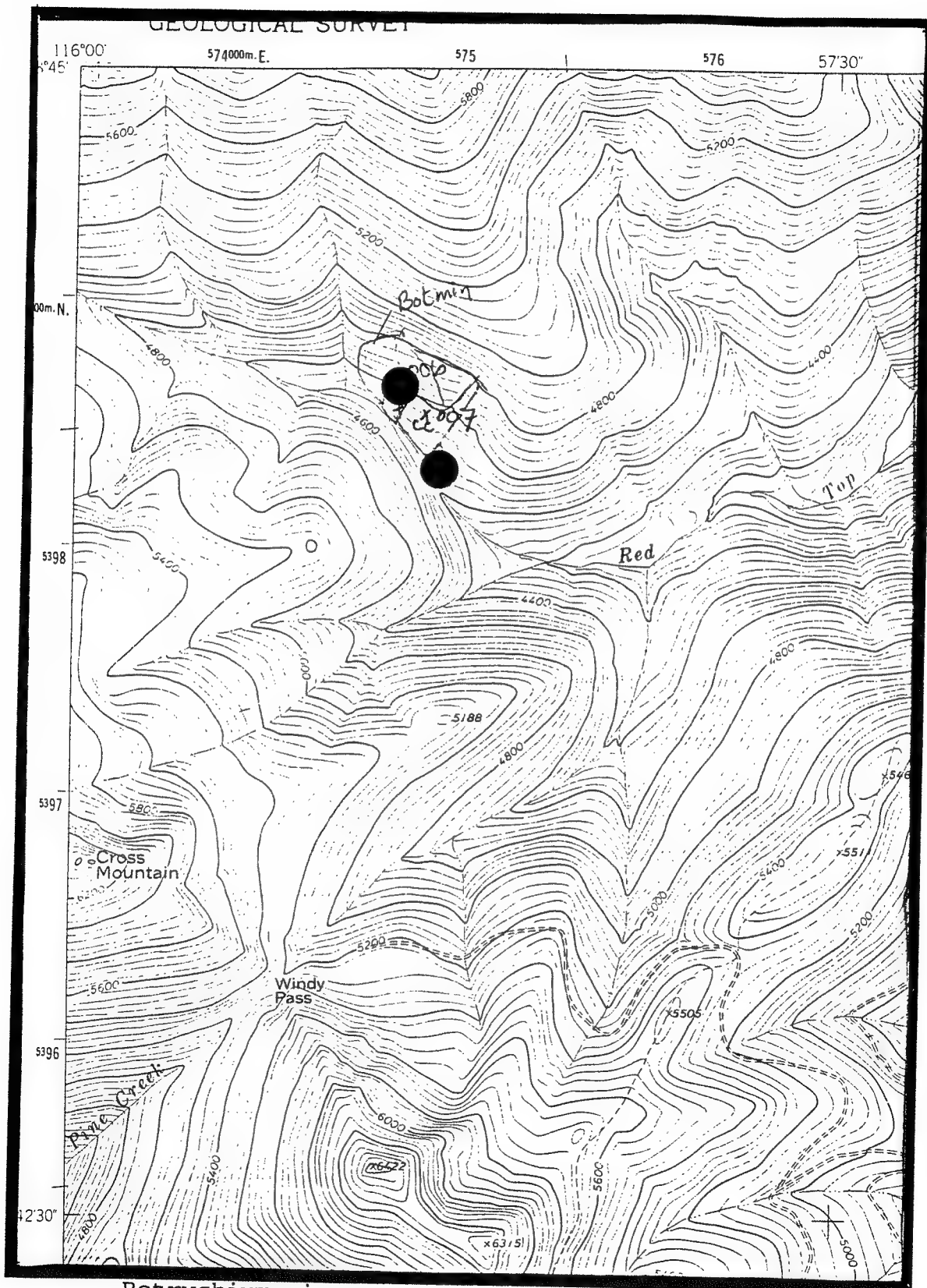
General site description:  
MOIST, SHADED, GLACIATED MOUNTAIN MIDSLOPE. LANDTYPE 352. GLACIAL TILL  
PARENT MATERIAL, ORGANIC SOIL. ASSOCIATED SPECIES: THUJA PLICATA,  
OPLOPANAX HORRIDUM, ATHYRIUM FILIX-FEMINA, GYMNOCARPIUM DRYOPTERIS,  
CLINTONIA UNIFLORA, TIARELLA TRIFOLIATA, SMILACINA STELLATA, GALIUM  
TRIFLORUM, ACER GLABRUM, BOTRYCHIUM PINNATUM, B. MONTANUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST AND L. FERGUSON. PLANTS GROWING NEXT TO  
CLEARCUT AREA LOGGED 5 YEARS AGO. ROAD RUNOFF IS MOVING ROCKS INTO  
FOREST DUFF. MANY MOONWORTS FOUND ON EDGE OF RUNOFF CHANNELS. ECODATA  
PLOT FS01140395JV006. PHOTOCOPY OF SPECIMEN DETERMINED BY P. ZIKA.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5458). 1995. MONTU.



Botrychium minganense; Red Top Creek (038)  
USGS Newton Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.039  
Element occurrence type:

Survey site name: FOWLER CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: LOST HORSE MOUNTAIN

Township: Range: Section: TRS comments:  
035N 031W 21 NE4NE4; 16 SE4 (UNSURVEYED SECTIONS)

Precision: S  
Survey date: Elevation: 4080 - 4240  
First observation: 1995-08-02 Slope/aspect: 0-5% / NORTH  
Last observation: 1995-08-02 Size (acres): 1

Location:  
CA. 1.8 AIR MILES WEST OF LOST HORSE MOUNTAIN, IMMEDIATELY ADJACENT TO  
FOWLER CREEK. ACCESS VIA FS RD 6063.

Element occurrence data:  
3 SUBPOPULATIONS. NORTHERN: 2 INDIVIDUALS; CENTER: 33 INDIVIDUALS,  
MANY JUST BEGINNING TO DEVELOP; SOUTHERN: 1 INDIVIDUAL. BOTH  
SPOROPHORES AND TROPOPHORES DEVELOPING.

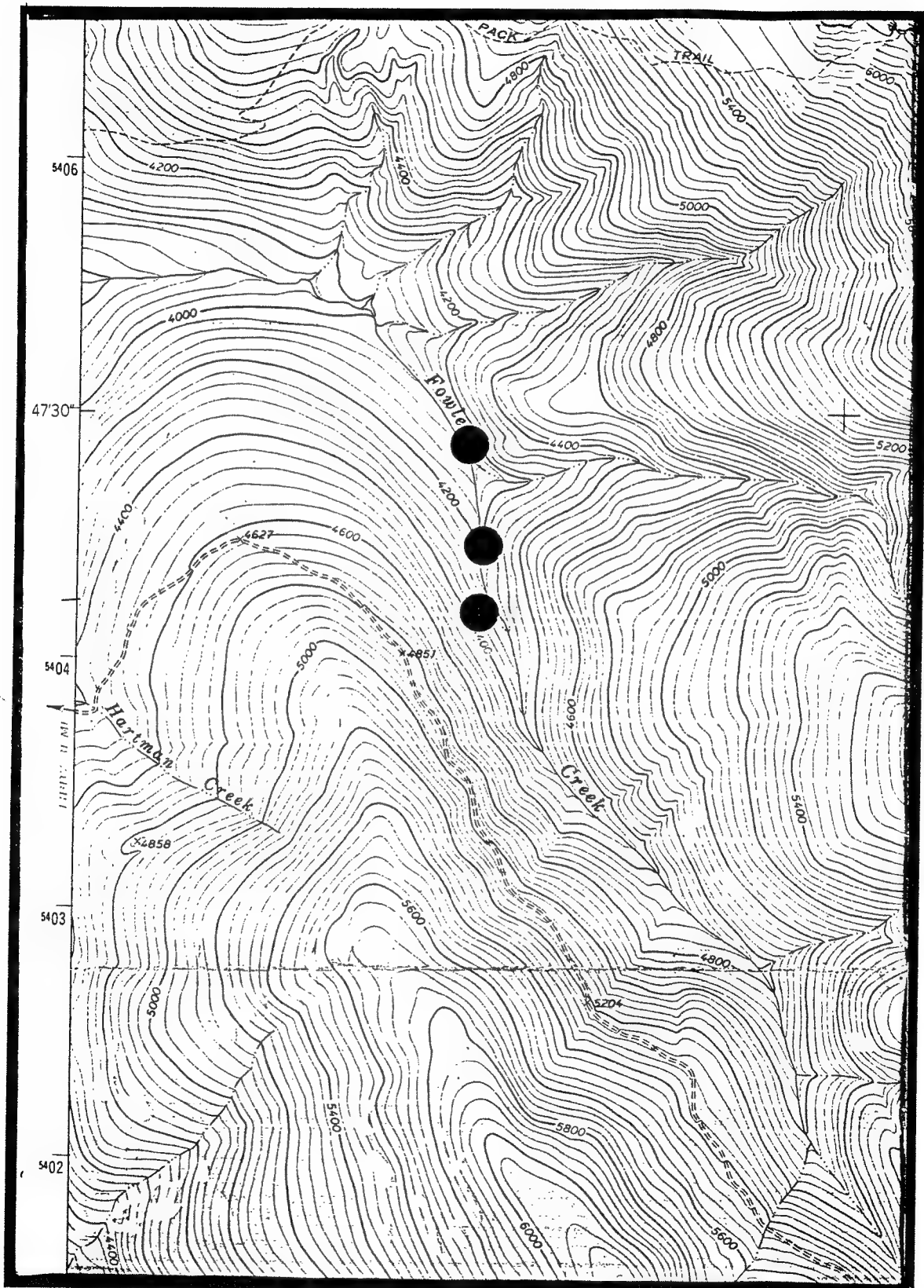
General site description:  
MOIST, PARTIALLY TO DEEPLY SHADED CREEK BOTTOM. THICK DUFF SOIL.  
LANDTYPE 352/357. ASSOCIATED SPECIES: THUJA PLICATA, PICEA  
ENGELMANNII, TSUGA HETEROPHYLLA, ABIES LASIOCARPA, OPLOPANAX HORRIDUM,  
LONICERA INVOLUCRATA, RUBUS PARVIFLORA, RIBES LACUSTRE, LINAEA  
BOREALIS, VACCINIUM MYRTILLUS, PACHISTIMA MYRSINITES, ALNUS TENUFOLIA,  
CORNUS STOLONIFERA, SORBUS SITCHENSIS, MENZIESIA FERRUGINEA, ACER  
GLABRUM, RUBUS PEDATUS, ARNICA CORDIFOLIA, SMILACINA STELLATA,  
CLINTONIA UNIFLORA, TIARELLA TRIFOLIATA, PYROLA UNIFLORA, GALIUM  
TRIFLORUM, VIOLA GLABELLA, ACTEA RUBRA, TRILLIUM OVATUM, OSMORHIZA  
CHILENSIS, STREPTOPUS AMPLEXIFOLIUS, THALICTRUM OCCIDENTALE, PYROLA  
CHLORANTHA, PYROLA ASARIFOLIA, MITELLA SP., HABENARIA SECCATA, SENECIO  
TRIANGULARIS, EPILOBIUM SP., CIRCAEA ALPINA, CYSTOPTERIS FRAGILIS,  
GYMNOCARPIUM DRYOPTERIS, ATHYRIUM FILIX-FEMINA, AND LYCOPODIUM  
ANNOTIUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY M. ARVIDSON AND L. SEDLER. DISTURBANCE BY FIRE IN 1994 AND  
FIRELINE CONSTRUCTED ADJACENT TO SITE.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens: ARVIDSON, M. (S.N.). 1995. THREE RIVERS RANGER  
DISTRICT.



Botrychium minganense; Fowler Creek (039)  
USGS Lost Horse Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.040  
Element occurrence type:

Survey site name: FOREST CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: MOUNT BALDY

Township: Range: Section: TRS comments:  
035N 034W 27 SE4 (UNSURVEYED SECTION)

Precision: S  
Survey date: Elevation: 4720 - 4920  
First observation: 1995-12-07 Slope/aspect: 20% / NE-NW  
Last observation: 1995-12-07 Size (acres): 5

Location:  
FOREST CREEK, CA. 0.9 AIR MILE NORTH OF RED TOP MOUNTAIN. FROM YAAK  
RIVER ROAD, FOLLOW SOUTH MEADOW CREEK ROAD (FS RD 524) CA. 7 MILES TO  
CROSSING OF FOREST CREEK. PLANTS ABOVE ROAD.

Element occurrence data:  
>50 PLANTS IN 2 SUBPOPULATIONS, ALL WITH IMMATURE SPORANGIA.

General site description:  
MOIST TO SATURATED, SHADED GLACIATED STREAM VALLEY LOWERSLOPE.  
LANDTYPE 252. SILTY DUFF SOIL. ASSOCIATED SPECIES: THUJA PLICATA,  
OPLOPANAX HORRIDUM, GYMNOCARPIUM DRYOPTERIS, CLINTONIA UNIFLORA,  
TIARELLA TRIFOLIATA, BOTRYCHIUM ASCENDENS, GALIUM TRIFLORUM, HIERACIUM  
ALBIFLORUM, TAXUS BREVIFOLIA, HABENARIA SACCATTA.

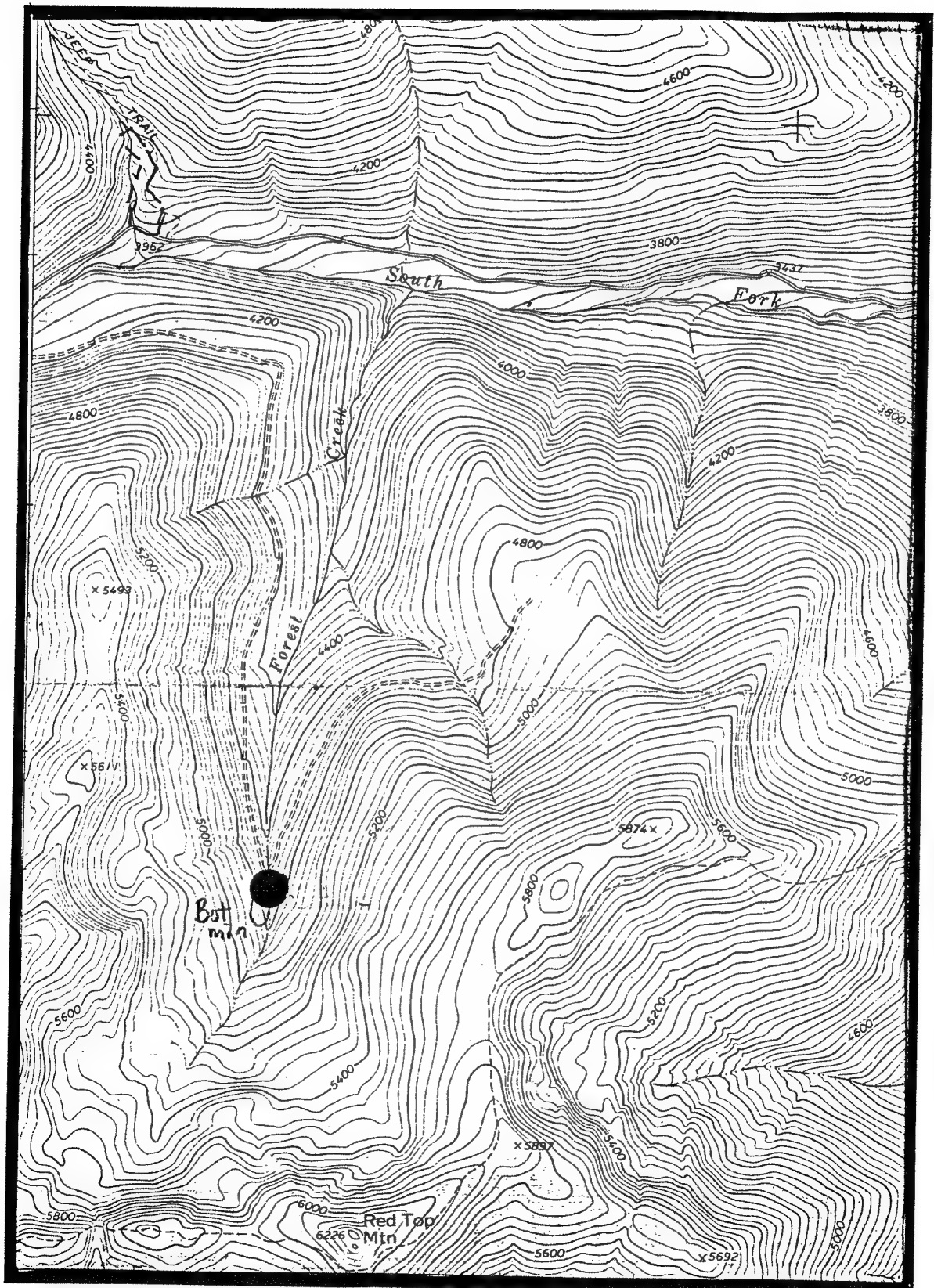
Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST. MINUTE PLANTS IN HEAVY SHADE OF DEVIL'S  
CLUB. HABITAT IS EXTENSIVE, BUT PLANTS WIDELY SCATTERED. PHOTOCOPY OF  
SPECIMEN DETERMINED BY P. ZIKA.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5523). 1995. MONTU.





*Botrychium minganense*; Forest Creek (040)  
USGS Mount Baldy 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4      Forest Service status: SENSITIVE  
State rank: S2S3      Federal Status:

Element occurrence code: PPOPH010R0.041  
Element occurrence type:

Survey site name: NORTH FORK DODGE CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: RED MOUNTAIN

Township:   Range:   Section:   TRS comments:  
037N      029W      26

Precision: M  
Survey date: 1995-08-12      Elevation: 4760 -  
First observation: 1971-07      Slope/aspect:  
Last observation: 1971-07      Size (acres):

Location:  
PURCELL MOUNTAINS, NEAR DODGE SUMMIT, SMALL SEEPING SPRING STREAM  
FLOWING INTO DODGE CREEK.

Element occurrence data:

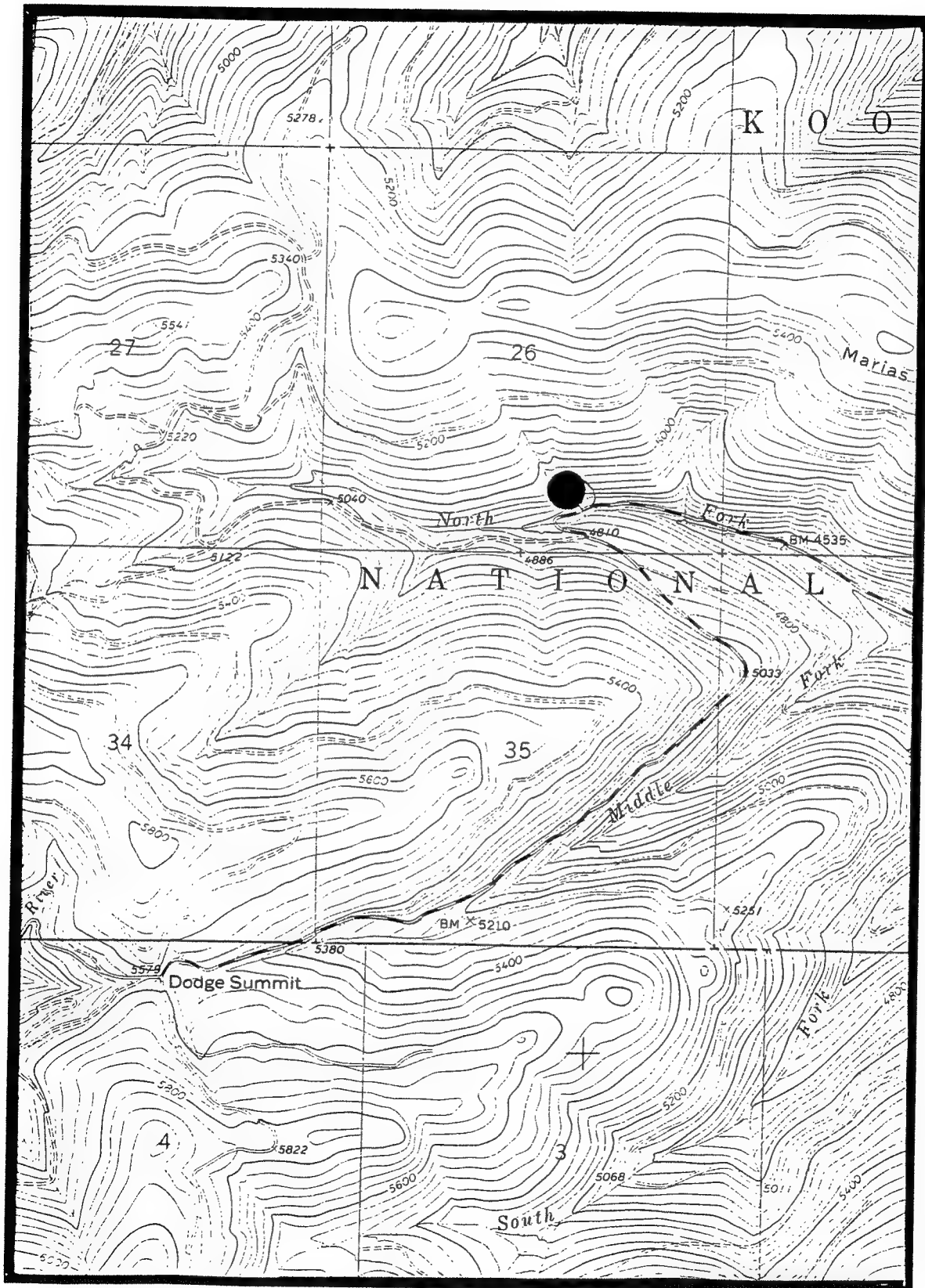
General site description:

Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
COLLECTED BY M. MOOAR IN 1971. AREA SURVEYED BY J. VANDERHORST IN  
1995, BUT NO MOONWORTS FOUND. MAPPED LOCATION IS AREA SURVEYED IN  
1995.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: MOOAR, M. (13321). 1971. MONTU.



Botrychium minganense; North Fork Dodge Creek (041)  
USGS Red Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.042  
Element occurrence type:

Survey site name: BRUSH CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: DUNSIRE POINT

Township: Range: Section: TRS comments:  
031N 026W 36 NE4SW4

Precision: S  
Survey date: Elevation: 4120 -  
First observation: 1993 Slope/aspect: 10% / WEST  
Last observation: 1995 Size (acres): 1

Location:  
SALISH MOUNTAINS, CA. 32 AIR MILES WEST OF LIBBY. TRIBUTARY OF BRUSH  
CREEK, IN SMALL CLEARING JUST ABOVE STREAM CONFLUENCE ON NORTH SIDE OF  
MAIN CREEK.

Element occurrence data:  
3 PLANTS WITH IMMATURE SPORANGIA.

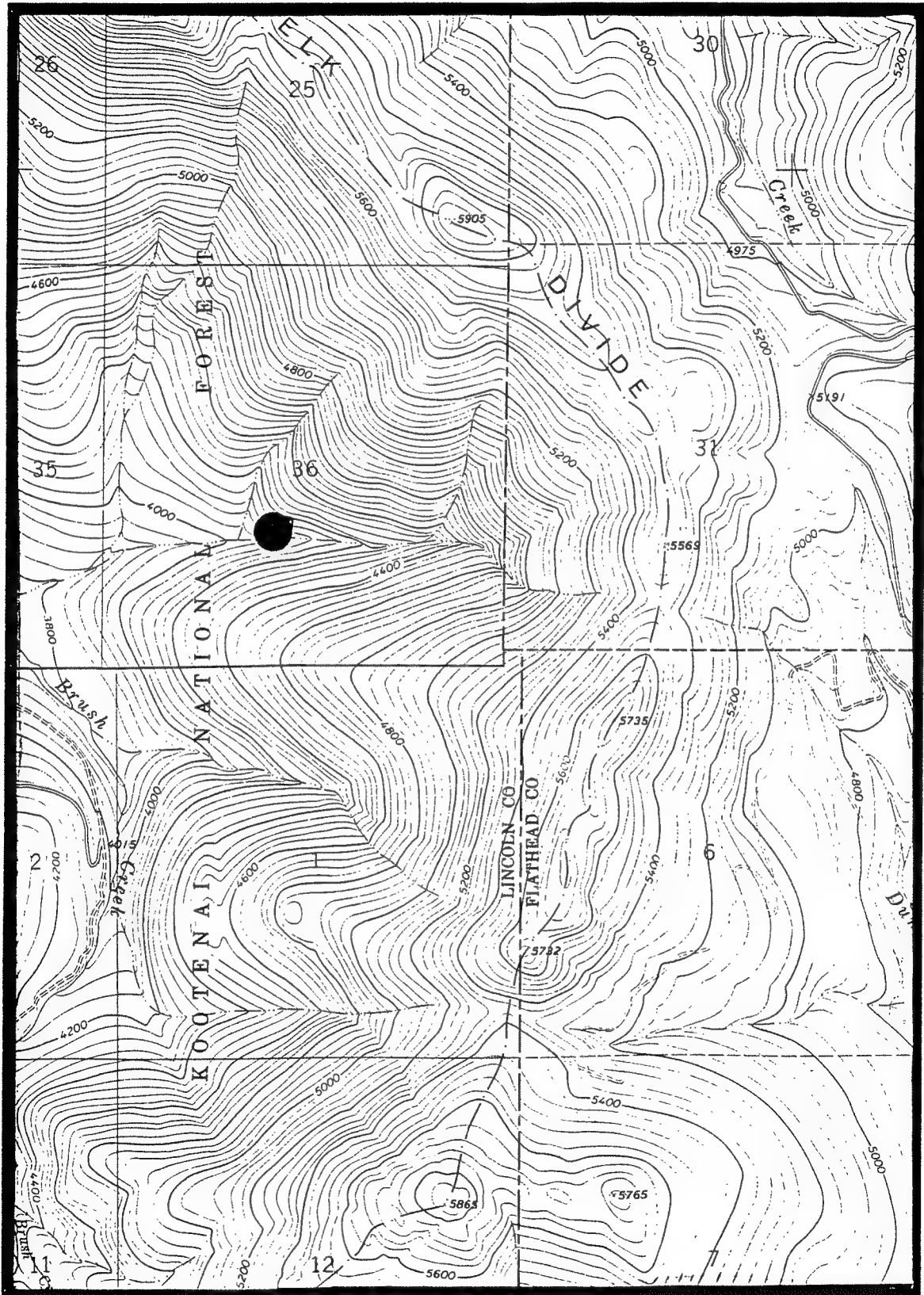
General site description:  
MOIST, PARTIALLY SHADED STREAM CONFLUENCE. LANDTYPE 352. ASSOCIATED  
SPECIES: PICEA SP., ABIES GRANDIS, SYMPHORICARPOS ALBUS, CLINTONIA  
UNIFLORA, ACER GLABRUM, RIBES LACUSTRE, RUBUS PARVIFOLIA, GALIUM  
TRIFLORUM, CIRCEA ALPINA, MITELLA NUDA, BOTRYCHIUM VIRGINIANUM,  
CALAMAGROSTIS CANADENSIS.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FISHER RIVER RANGER DISTRICT

Comments:  
OBSERVED BY J. RENY. DISTURBANCE BY GAME TRAILS. SITE REVISITED BY J.  
RENY IN 1994 AND 1995, BUT NO PLANTS WERE FOUND. IDENTIFICATION AS B.  
MINGANENSE TENTATIVE; NO VOUCHERS TAKEN.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:



Botrychium minganense; Brush Creek (042)  
USGS Dunshire Point 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.043  
Element occurrence type:

Survey site name: GRAVE CREEK CAMPGROUND  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: FORTINE

Township: Range: Section: TRS comments:  
035N 025W 6 SW4

Precision: S  
Survey date: Elevation: 3120 -  
First observation: 1995-08-05 Slope/aspect: LEVEL  
Last observation: 1995-08-05 Size (acres):

Location:

GRAVE CREEK CAMPGROUND. CA. 3.5 MILES UP GRAVES CREEK ROAD FROM HWY  
93. FOLLOW CAMPGROUND ROAD SOUTHWEST TO TURNAROUND. PLANTS ARE 20  
PACES SSW, CA. 100 FEET FROM STREAM BANK.

Element occurrence data:  
12 PLANTS.

General site description:

SHADED GLACIATED VALLEY BOTTOM. ASSOCIATED SPECIES: POPULUS  
BALSAMIFERA, ACER GLABRUM, SYMPHORICARPOS ALBA, RUBUS PARVIFLORA,  
BETULA PAPYRIFERA, PSEUDOTSUGA MENZIESII, PICEA ENGELMANNII, BERBERIS  
REPENS, LINNAEA BOREALIS, ARALIA NUDICAULIS, SMILACINA STELLATA,  
GALIUM TRIFLORUM.

Land owner/manager:

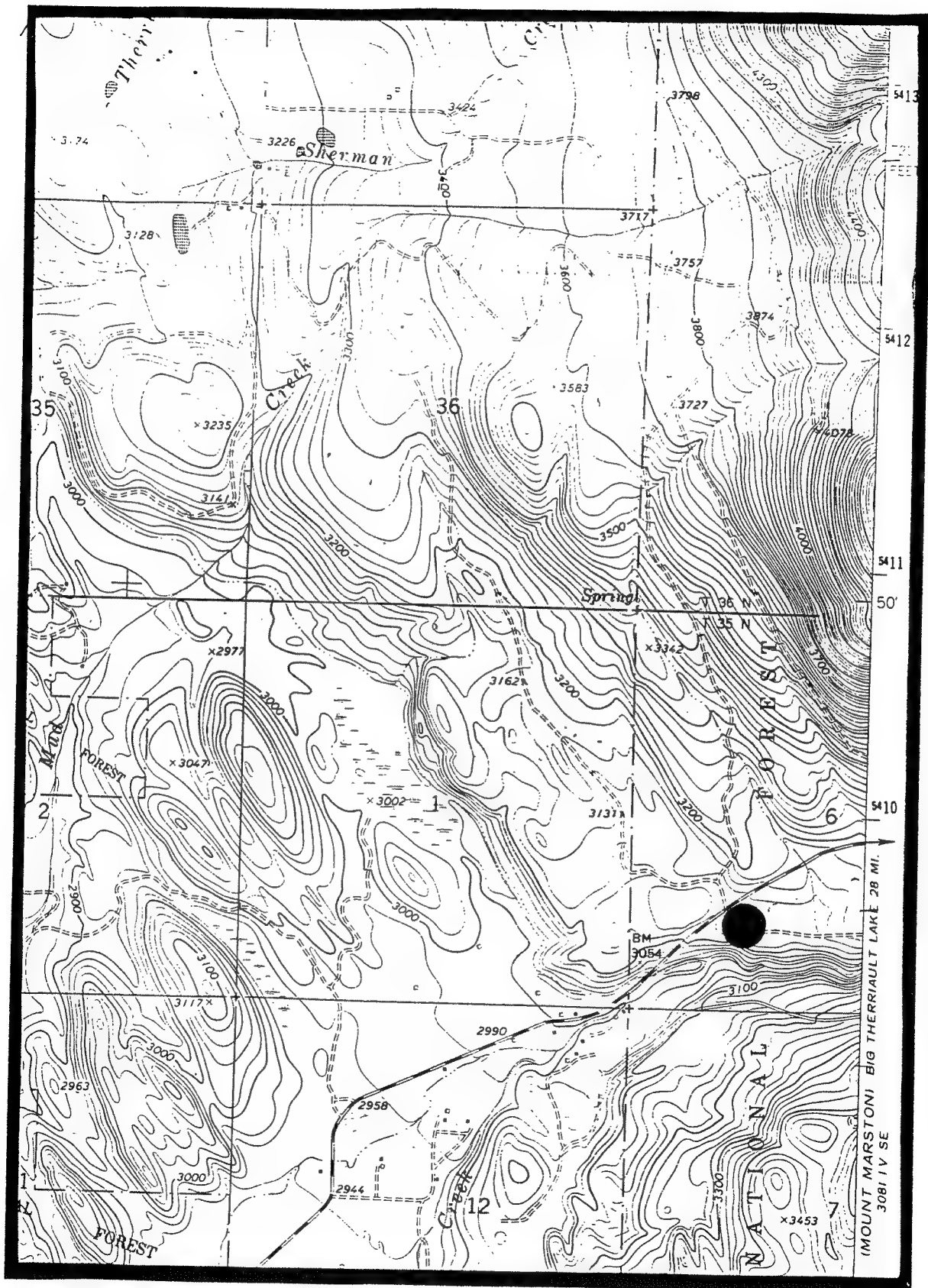
KOOTENAI NATIONAL FOREST, FORTINE RANGER DISTRICT

Comments:

OBSERVED BY K. HUNGATE AND M. LOLLY. IDENTIFICATION MADE BY J.  
VANDERHORST. ECODATA PLOT FS01140395TI102.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: HUNGATE, K. (S.N.). 1995. KNF HERBARIUM.



*Botrychium minganense*; Grave Creek Campground (043)  
USGS Fortine 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.044  
Element occurrence type:

Survey site name: CAN CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: FLATIRON MOUNTAIN

Township: Range: Section: TRS comments:  
035N 031W 32 SW4 (UNSURVEYED SECTION)

Precision: S  
Survey date: Elevation: 3760 -  
First observation: 1995-09-05 Slope/aspect: LEVEL  
Last observation: 1996-08-04 Size (acres): 1

Location:  
LOWER CAN CREEK, CA. 6.5 AIR MILES SSE OF YAAK. ACCESS FROM YAAK-PIPE  
CREEK ROAD (FS RD 68). FROM ROAD, WALK UP THROUGH OLD CLEARCUT AND  
DOWN INTO CREEK BOTTOM ABOVE THE UNIT.

Element occurrence data:  
1996: 3 PLANTS FOUND. 1995: CA. 20 PLANTS, 100% WITH IMMATURE  
SPOROPHORES.

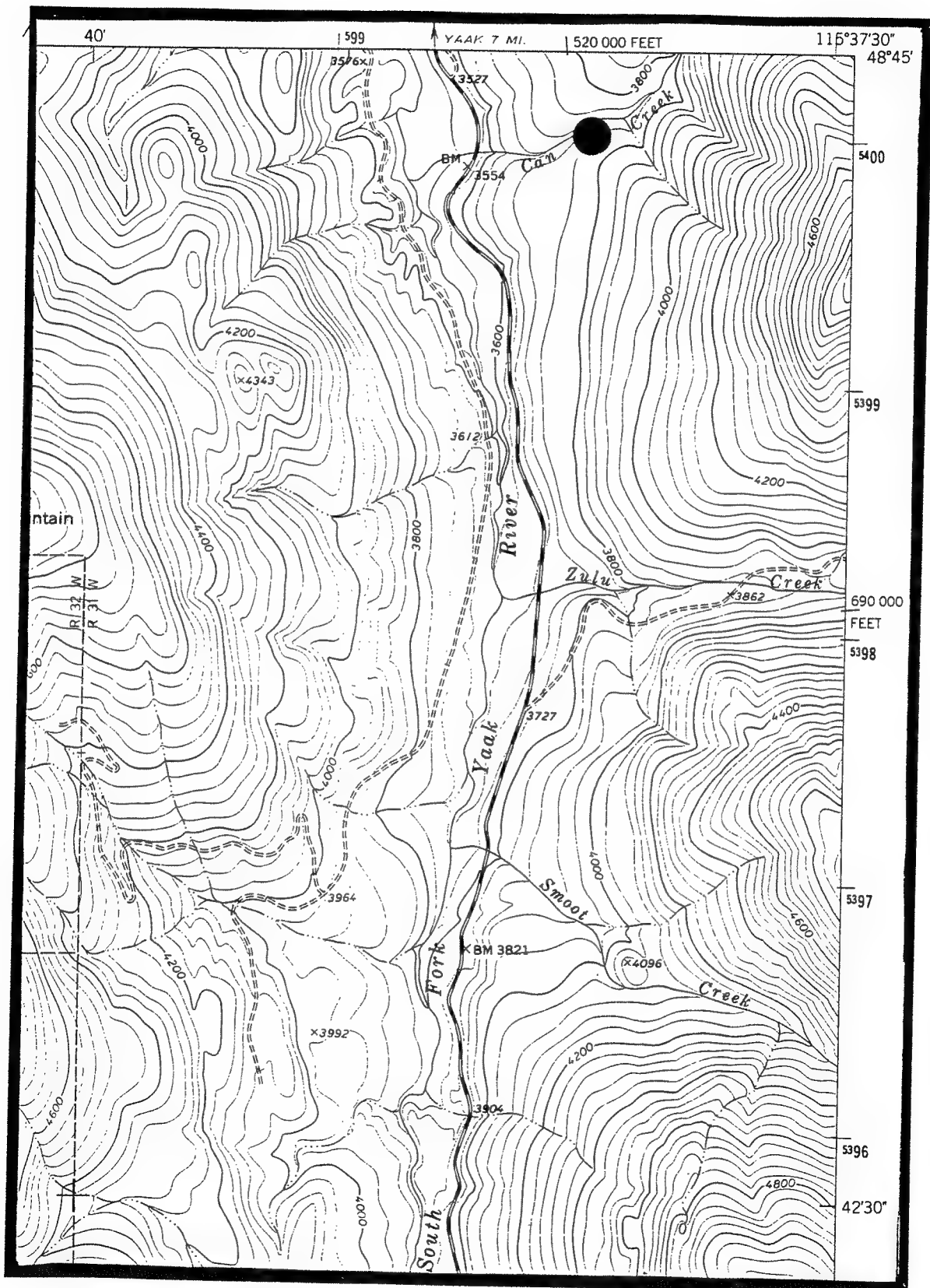
General site description:  
MOIST, SHADED, GLACIATED VALLEY BOTTOM WITH DUFF SOIL. ASSOCIATED  
SPECIES: THUJA PLICATA, CLINTONIA UNIFLORA, POPULUS BALSAMORHIZA,  
GALIUM TRIFLORUM, ARNICA CORDIFOLIA, SMILACINA STELLATA, MITELLA NUDA,  
BOTRYCHIUM VIRGINIANUM, B. MONTANUM, SYMPHORICARPOS ALBUS,  
GYMNOCARPIUM DRYOPTERIS.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST, L. FERGUSON, AND M. ARVIDSON. ECODATA PLOT  
FS01140296JV010.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



Botrychium manganense; Can Creek (044)  
USGS Flatiron Mountain 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4      Forest Service status: SENSITIVE  
State rank: S2S3      Federal Status:

Element occurrence code: PPOPH010R0.045  
Element occurrence type:

Survey site name: SWAMP CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: DAVIS MOUNTAIN

Township: Range: Section: TRS comments:  
033N      027W      26      SW4NE4

Precision: S  
Survey date:      Elevation: 4000 -  
First observation: 1995-08-25      Slope/aspect: 0% / SOUTH  
Last observation: 1995-08-25      Size (acres):

Location:  
SWAMP CREEK, CA. 1 AIR MILES SOUTHWEST OF TREGO. FROM TREGO, FOLLOW  
COUNTY RT. 36 TO JUNCTION WITH COUNTY RT. 48. FOLLOW 48 CA. 6.5 MILES  
TO BRIDGE ACROSS SWAMP CREEK, TURN SOUTH ON FS RD 3614, AND FOLLOW 0.5  
MILE TO CLEARCUT WITH ASPEN GROVE.

Element occurrence data:  
1 PLANT WITH DISPERSED SPORES.

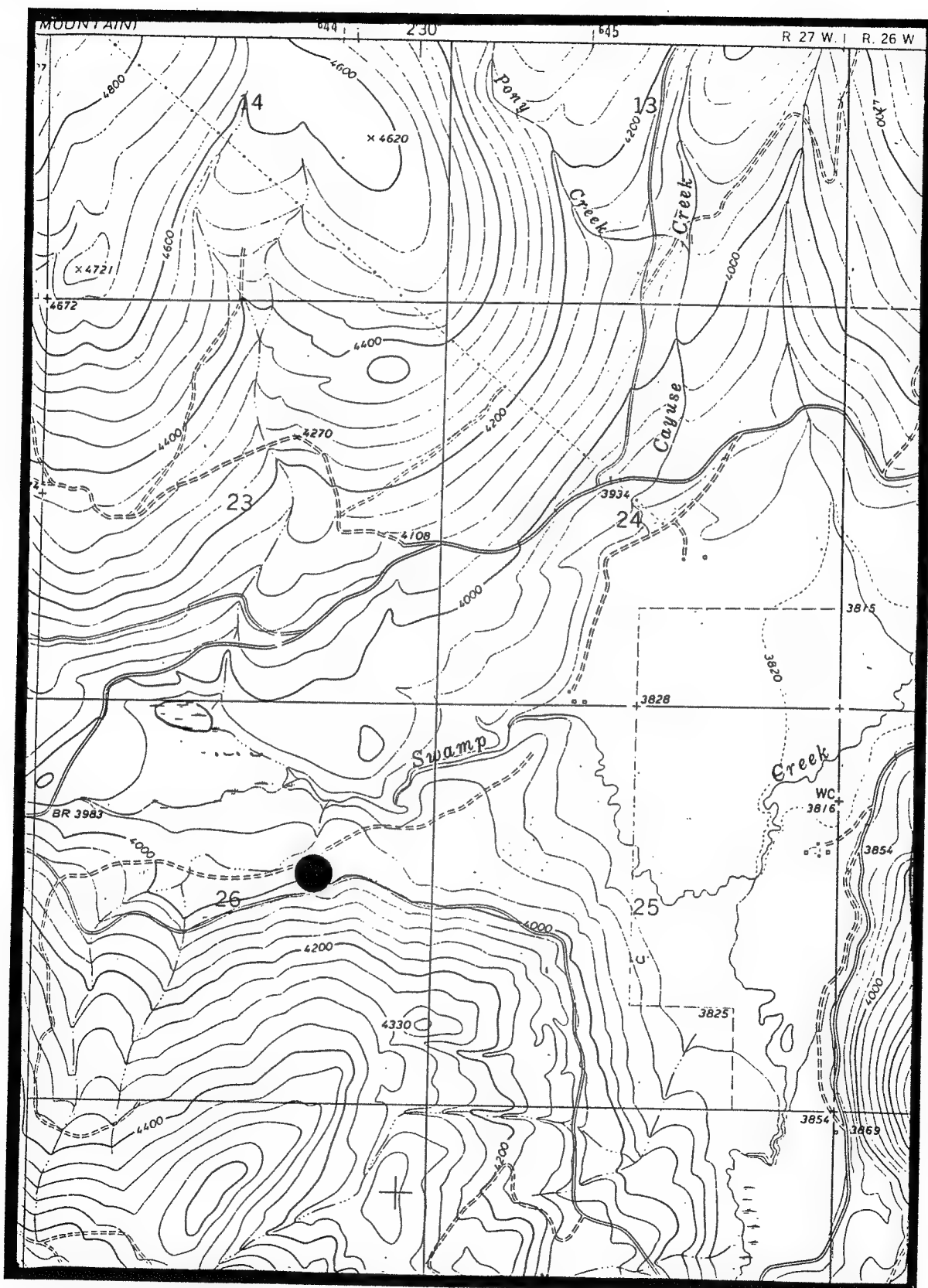
General site description:  
MOIST, PARTIALLY-SHADED, GLACIATED VALLEY BENCH WITH SILTY HUMUS SOIL.  
ASSOCIATED SPECIES: POPULUS TREMULOIDES, PICEA ENGELMANNII, CORNUS  
STOLONIFERA, RHAMNUS ALNIFOLIA, EQUISETUM SCIRPOIDES, CORNUS  
CANADENSIS, SMILACINA STELLATA, LISTERA SP., FRAGARIA VIRGINIANA,  
BOTRYCHIUM CRENULATUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FORTINE RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST. MOONWORTS GROWING IN ASPEN GROVE  
SURROUNDED BY CLEARCUTS. DEAD ASPEN PROBABLY KILLED BY SLASH BURNING.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5550B). 1995. MONTU.



*Botrychium minganense*; Swamp Creek (045)  
USGS Davis Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4      Forest Service status: SENSITIVE  
State rank: S2S3      Federal Status:

Element occurrence code: PPOPH010R0.046  
Element occurrence type:

Survey site name: SOUTH FORK BIG CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: PARSNIP MOUNTAIN

Township: Range: Section: TRS comments:  
034N      030W      4      NE4

Precision: S  
Survey date:      Elevation: 3200 -  
First observation: 1995      Slope/aspect:  
Last observation: 1996-07-24      Size (acres):

Location:  
BIG CREEK, CA. 0.3 MILE DOWNSTREAM FROM CONFLUENCE WITH COPELAND  
CREEK. ACCESS FROM WEST SIDE OF LAKE KOOCANUSA UP BIG CREEK ROAD (FS  
RD 336).

Element occurrence data:  
1996: CA. 50 PLANTS SEEN.

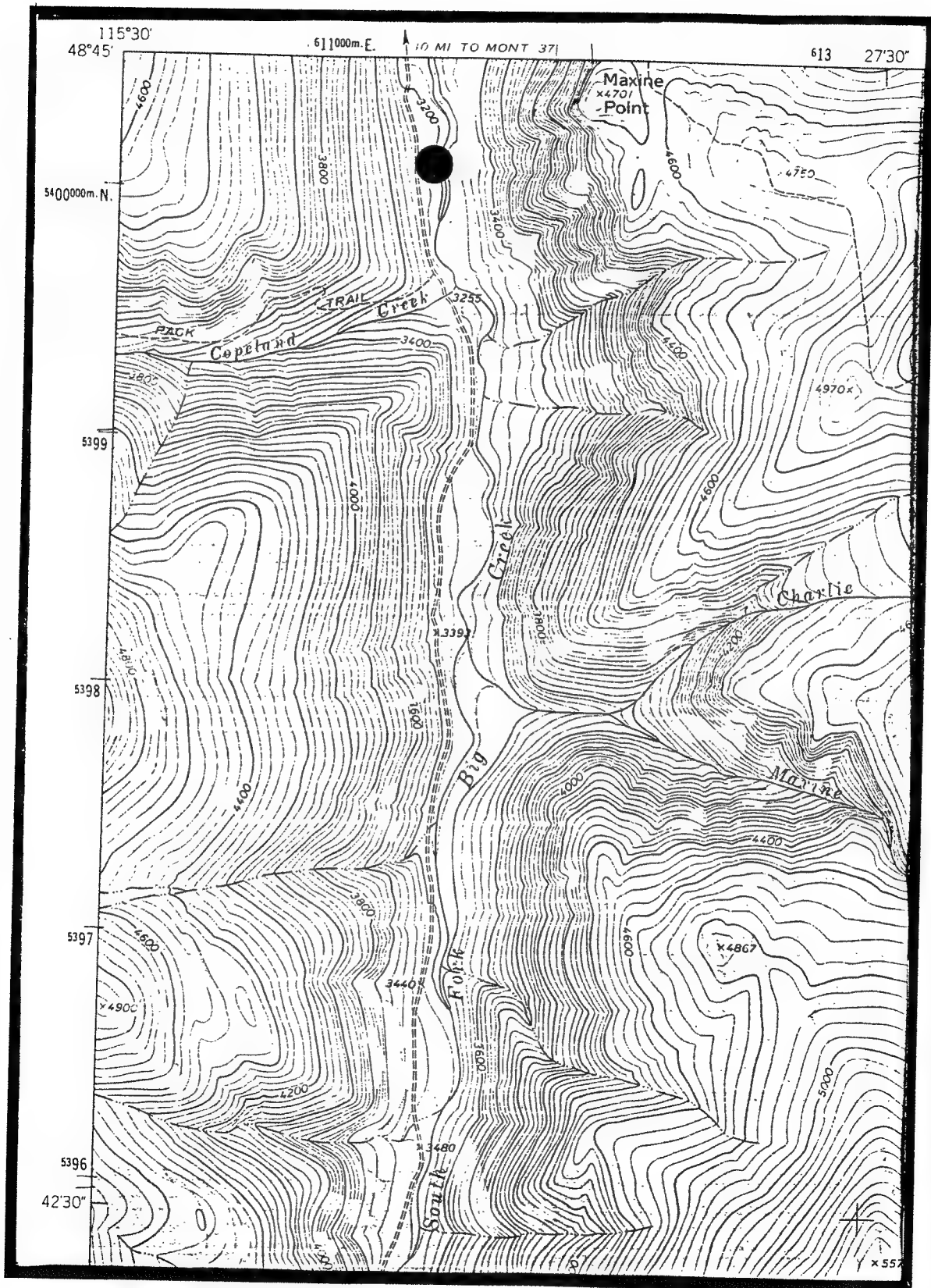
General site description:  
FLOODPLAIN BOTTOM, THUJA PLICATA/OPLOPANAX HORRIDUM HT, WITH TIARELLA  
TRIFOLIATA, CLINTONIA UNIFLORA, TAXUS BREVIFOLIA, BOTRYCHIUM MONTANUM,  
B. LANCEOLATUM, B. VIRGINIANUM, AND B. PEDUNCULOSUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
OBSERVED BY A. DUEKER IN 1995.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens: VANDERHORST, J. (5608). 1996. MONTU.



Botrychium minganense; South Fork Big Creek (046)  
USGS Parship Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.047  
Element occurrence type:

Survey site name: BULL RIVER  
EO rank: C  
EO rank comments: ONLY 3 SMALL PLANTS.

County: SANDERS

USGS quadrangle: IBEX PEAK

Township: Range: Section: TRS comments:  
028N 033W 11 NW4SE4, NE4SW4

Precision: S  
Survey date: 1996-08-11 Elevation: 2560 -  
First observation: 1996-06-28 Slope/aspect: LEVEL  
Last observation: 1996-08-11 Size (acres): 1

Location:  
FROM TOWN OF BULL RIVER, GO WEST CA. 1.5 MILES ON HWY 200, THEN TURN  
NORTH ONTO HWY 56 AND GO CA. 13 MILES. FROM HWY 56, TURN ONTO FS RD  
410 AND GO CA 2 MILES. THEN TURN ONTO FS RD 2722 AND GO CA. 0.5 MILES  
TO THE MIDDLE FORK OF BULL RIVER TRAIL HEAD. FOLLOW THIS TRAIL TO THE  
CROSSING OF A TRIBUTARY STREAM. PLANTS ARE DOWNSTREAM CA. 100 FEET, 30  
FEET FROM THE STREAM.

Element occurrence data:  
IMMATURE FRONDS ON 28 JUNE, PAST SPORE DISPERSAL ON 11 AUGUST. 3  
INDIVIDUAL PLANTS, BUT ONLY TWO REMAINING ON 11 AUGUST.

General site description:  
MOIST, UNDULATING, SHADED BOTTOM, SILTY SOILS WITH 1 INCH LITTER  
LAYER, ALLUVIUM PARENT MATERIAL. THUJA PLICATA/CLINTONIA UNIFLORA HT,  
WITH PICEA, ABIES GRANDIS, PSEUDOTSUGA MENZIESII, COPTIS OCCIDENTAL,  
TRILLIUM OVATUM, ROSA WOODSII, OSMORHIZA DEPAUPERATA, LINNAEA  
BOREALIS, SMILACINA STELLATA, RHYTIDIOPSIS ROBUSTA (MOSS), PLAGIOMNIUM  
SP. (MOSS).

Land owner/manager:  
KOOTENAI NATIONAL FOREST, CABINET RANGER DISTRICT

Comments:  
COUNTY RECORD FOR SPECIES. ECODATA PLOT #FS01140796JV014.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5620). 1996. MONTU.



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4      Forest Service status: SENSITIVE  
State rank: S2S3      Federal Status:

Element occurrence code: PPOPH010R0.048  
Element occurrence type:

Survey site name: UPPER WHITETAIL CREEK  
EO rank: C  
EO rank comments: HIGH VIGOR BUT FEW PLANTS; SURROUNDED BY  
CLEARCUTS.

County: LINCOLN

USGS quadrangle: CLARK MOUNTAIN

Township: Range: Section: TRS comments:  
036N      033W      25      NW4

Precision: S  
Survey date: 1996-07-01      Elevation: 4280 -  
First observation: 1996-07-01      Slope/aspect: 25% / SW  
Last observation: 1996-07-01      Size (acres):

Location:  
WHITETAIL CREEK DRAINAGE. FROM TOWN OF YAAK, GO CA. 6.5 MILES WEST ON  
HWY 508, THEN TURN NORTH ONTO FS RD 435 FOR CA. 1.5 MILES, THEN TURN  
EAST ONTO FS RD 5932 TO THE FIRST SWITCHBACK AFTER CROSSING WHITETAIL  
CREEK (CA. 3 MILES). PLANTS ARE DOWNHILL IN HEAVY TIMBER BETWEEN UPPER  
AND LOWER ROAD.

Element occurrence data:  
23 INDIVIDUALS COUNTED; 100% WITH SPORANGIA; 1 SUBPOPULATION.

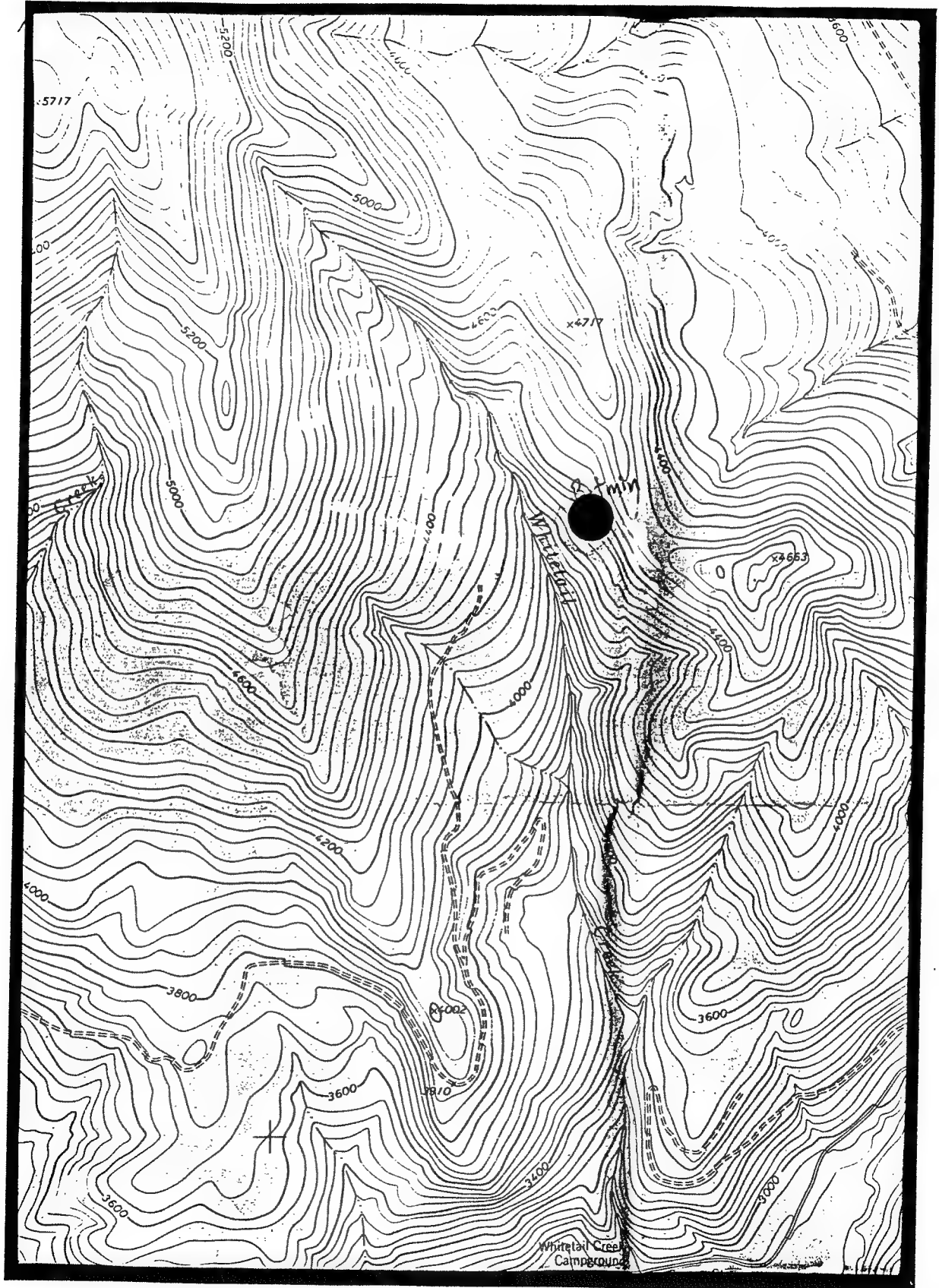
General site description:  
MOIST, PARTIAL SHADE GLACIATED MIDSLOPE, HEAVY COMPACTED LITTER,  
ORGANIC PARENT. TSUGA HETEROPHYLLA/CLINTONIA UNIFLORA HT, WITH ARNICA  
CORDIFOLIA, GOODYERA OBLONGIFOLIA, VACCINIUM MEMBRANACEUM, ORTHILLA  
SECUNDA, SMILACINA STELLATA, PTERIDIUM AQUILINUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, CABINET RANGER DISTRICT

Comments:  
AREA MAY BE WITHIN PROPOSED TIMBER SALE UNIT.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



*Botrychium minganense*; Upper Whitetail Creek (048)  
USGS Clark Mountain 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.049  
Element occurrence type:

Survey site name: SUTTON CREEK  
EO rank: A  
EO rank comments: LARGE POPULATION IN GENUS COMMUNITY, VIGOROUS  
PLANTS.

County: LINCOLN

USGS quadrangle: BEARTRAP MOUNTAIN

Township: Range: Section: TRS comments:  
035N 028W 33 NW4

Precision: S  
Survey date: 1996-07-11 Elevation: 3120 - 3200  
First observation: 1996-07-11 Slope/aspect: LEVEL  
Last observation: 1996-07-11 Size (acres): 5

Location:  
SUTTON CREEK. FROM TOWN OF EUREKA, GO NORTH ON HWY 93 CA. 1 MILE, THEN  
WEST ONTO HWY 37 CA. 14 MILES. THEN TURN ONTO FS RD 619 AND GO CA. 3.1  
MILES TO SWITCHBACK. POPULATION IS SOUTH OF SWITCHBACK CA. 0.12 MILES  
IN CREEK BOTTOM.

Element occurrence data:  
100+ PLANTS, 100% WITH IMMATURE SPORANGIA

General site description:  
SHADY MOIST BOTTOM. ORGANIC, HEAVY DUFF OVER ROCKY ALLUVIUM. THUJA  
PLICATA/OPLOPANAX HORRIDUM HT, WITH CLINTONIA UNIFLORA, POPULUS  
BALSAMIFERA, BOTRYCHIUM MONTANUM, SMILACINA STELLATA, GOODYERA  
OBLONGIFOLIA, MITELLA NUDA, BOTRYCHIUM VIRGINIANUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
BEAVER DAM BELOW POPULATION; FLOODING OF POTENTIAL HABITAT IN SPRING,  
1996.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5589). 1996. MONTU.



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.050  
Element occurrence type:

Survey site name: POORMAN CREEK  
EO rank: B  
EO rank comments: PLANTS MINUTE, SPINDLY.

County: LINCOLN

USGS quadrangle: CABLE MOUNTAIN

Township: Range: Section: TRS comments:  
028N 031W 35 SW4

Precision: S  
Survey date: 1996-07-28 Elevation: 3640 -  
First observation: 1996-07-28 Slope/aspect:  
Last observation: 1996-07-28 Size (acres): 5

Location:  
CABINET MOUNTAINS, POORMAN CREEK. FROM LIBBY FOLLOW HWY 2, THEN FS RD  
231 SOUTH TO FS RD 278. FOLLOW FS RD 278 THEN FS RD 6201 TO JUNCTION  
WITH FS RD 14405. PLANTS ARE UPSTREAM ON NORTH SIDE OF CREEK.

Element occurrence data:  
8 PLANTS COUNTED; SCARCE AND SCATTERED. 100% WITH IMMATURE SPORANGIA.

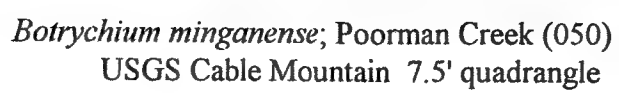
General site description:  
MOIST, UNDULATING, SHADY BOTTOM WITH EVIDENCE OF PAST FLOOD EVENTS.  
SOILS: COMPACTED DUFF OVER ALLUVIUM. ASSOCIATED PLANT SPECIES: THUJA  
PLICATA, TSUGA HETEROPHYLLA, POPULUS BALSAMIFERA, OPLOPANAX HORRIDUM,  
GYMNOCARPIUM DRYOPTERIS. ADDITIONAL ASSOCIATED PLANT SPECIES INCLUDE:  
BOTRYCHIUM LANCEOLATUM, TIARELLA TRIFOLIATA AND CLINTONIA UNIFLORA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
AREA DESIGNATED BY SIGN AS 'PROTECTED STREAM COURSE.'

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



*Botrychium minganense*; Poorman Creek (050)  
USGS Cable Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.051  
Element occurrence type:

Survey site name: BASIN CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: ROBINSON MOUNTAIN

Township: Range: Section: TRS comments:  
036N 030W 04 SE4

Precision: S  
Survey date: Elevation: 4100 -  
First observation: 1996-07-30 Slope/aspect: LEVEL  
Last observation: 1996-07-30 Size (acres): 2

Location:  
FROM CARIBOU CAMPGROUND ON EAST FORK YAAK RIVER, TAKE FS RD 337 TO FS  
RD 14725. POPULATION IS ACROSS THE CREEK AND WITHIN 100 FT. OF THE  
ROAD JUST WEST OF JUNCTION.

Element occurrence data:  
38 PLANTS, SPORES PRESENT.

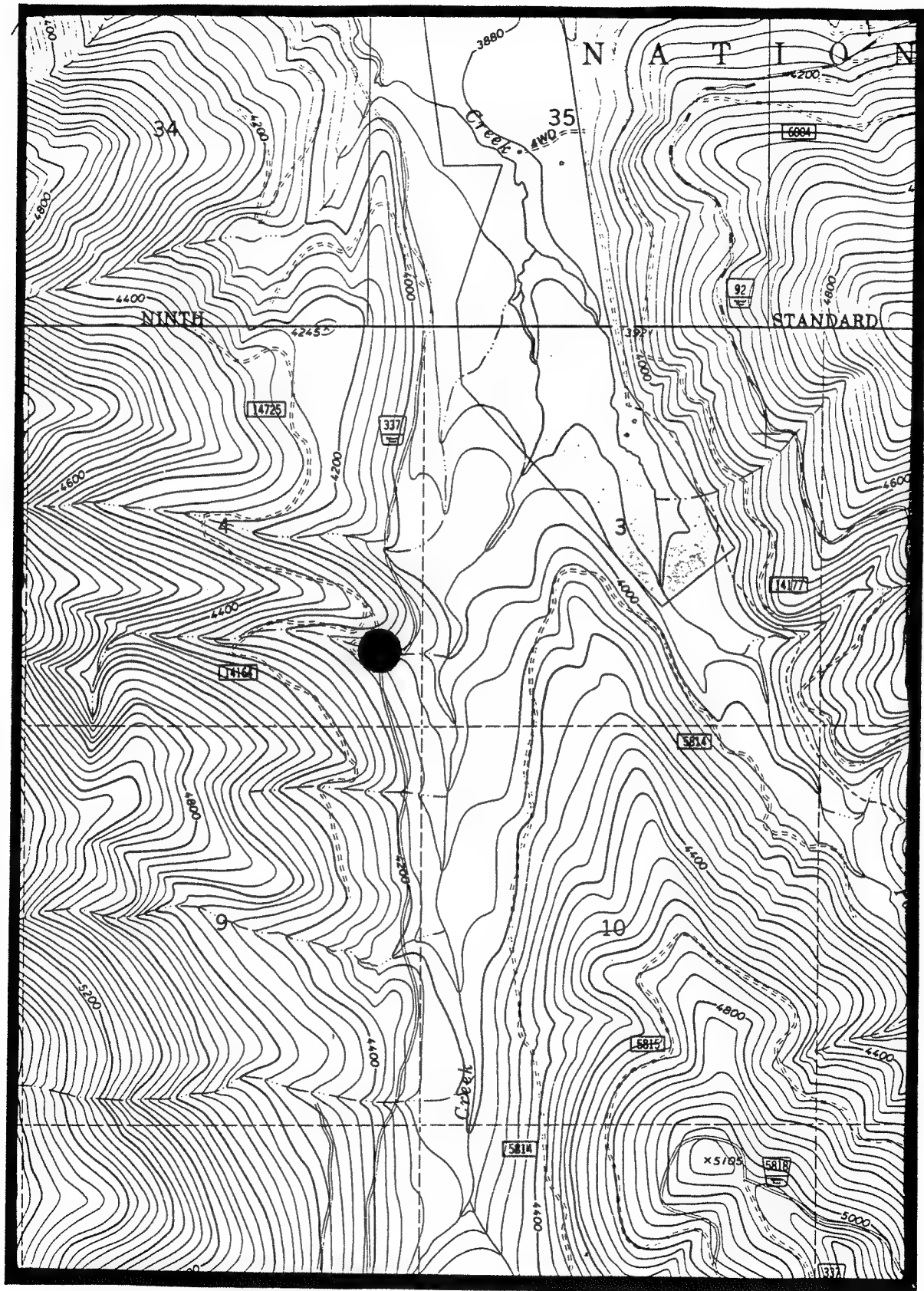
General site description:  
MOIST, SHADED BOTTOM SWALES, THICK DUFF LAYER. ASSOCIATED SPECIES:  
TSUGA HETEROPHYLLA, LARIX OCCIDENTALIS, LINNAEA BOREALIS, RHIZOMNIUM  
SPP., ARNICA LATIFOLIA, BOTRYCHIUM VIRGINIANUM, PLATANATHERA STRICTA,  
TIARELLA TRIDENTATA, RIBES LACUSTRE, GALIUM TRIFLORUM, PYROLA  
UNIFLORA, BROMUS VULGARIS, CLINTONIA UNIFLORA, OSMORHIZA CHILENSIS,  
PICEA ENGELMANNII, LISTERA CORDATA, STREPTOPUS AMPLEXIFOLIUS,  
CHIMAPHILA UMBELLATA, GYMNOCARPIUM DRYOPTERIS, ATHYRIUM FILIX-FEMINA,  
GOODYERA OBLONGIFOLIA, LISTERA CAURINA, AND MOSSES.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY M. ARVIDSON. OLD SKID TRAILS ADJACENT TO POPULATION AND  
OLD PARTIAL CUT NEARBY.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:



*Botrychium minganense*; Basin Creek (051)  
USGS Robinson Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4      Forest Service status: SENSITIVE  
State rank: S2S3      Federal Status:

Element occurrence code: PPOPH010R0.053  
Element occurrence type:

Survey site name: DOAK CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: LIBBY

Township: . Range: Section: TRS comments:  
031N      031W      12      SE4NW4

Precision: S  
Survey date:      Elevation: 3160 - 3200  
First observation: 1996-06-25      Slope/aspect: 03% / NW  
Last observation: 1996-06-25      Size (acres): 2

Location:  
FROM LIBBY, GO NORTH ON HWY 68 (PIPE CREEK ROAD) CA. 4 MILES, THEN  
TAKE FS RD 4753 (SHELDON MT ROAD) CA. 3 MILES TO A SPUR ON RIGHT. PARK  
AT GATE, WALK PAST EXISTING HARVEST ON LEFT. SITE IS ALONG ROAD DITCH  
ON LEFT.

Element occurrence data:  
100+ INDIVIDUALS; 90% IN FLOWER, 10% WITH FRUIT.

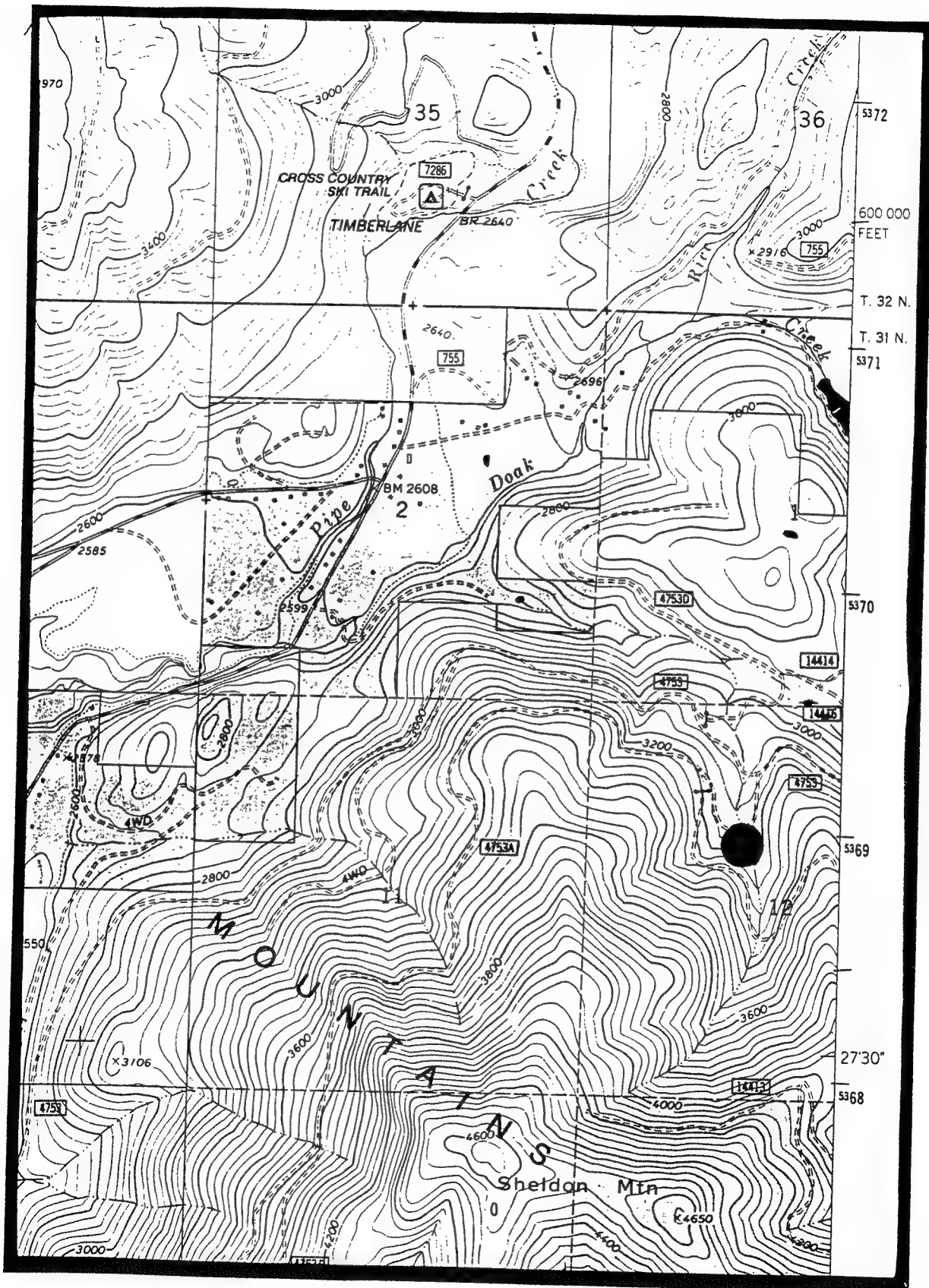
General site description:  
SITE IS A DRAINAGE DITCH ALONG ROADSIDE UNDER A CLOSED CANOPY; SHADY  
AND MOSSY WITH THICK DUFF. LARCH DOMINATE OVERSTORY, CEDAR DOMINANT IN  
MID AND UNDERSTORY. ASSOCIATED SPECIES: LARIX OCCIDENTALIS,  
PSEUDOTSUGA MENZIESII, THUJA PLICATA, ALNUS SINUATA, CORNUS  
STOLONIFERA, LINNAEA BOREALIS, RIBES LACUATRE, ROSA ACICULARIS, RUBUS  
PARVIFLORUS, ARABIS NUTTALLII, CLINTONIA UNIFLORA, CONYZA CANADENSIS,  
GALIUM TRIFLORUM, GEUM MACROPHYLLUM, HABENARIA SACCATA, MITELLA NUDA,  
OSMORHIZA CHILENSIS, PYROLA ASARIFOLIA, SMILACINA STELLATA, VIOLA  
GLABELLA, EQUISETUM, BOTRYCHIUM VIRGINIANUM, B. MINGANENSE,  
GYMNOCARPIUM DRYOPTERIS, GLYCERIA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
OBSERVED BY THERESE BIELAK AND JON RENY. SPECIMEN COLLECTED.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens: BIELAK, T. AND J. RENY (S.N.). 1996. KOOTENAI NF SO.



*Botrychium minganense*; Doak Creek (053)  
USGS Libby 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.054  
Element occurrence type:

Survey site name: WEIGEL CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: WARLAND PEAK

Township: Range: Section: TRS comments:  
031N 027W 26 NW4

Precision: S  
Survey date: Elevation: 4760 -  
First observation: 1996-07-22 Slope/aspect: 0-5% / NORTH TO NORTHWEST  
Last observation: 1996-07-22 Size (acres): 1

Location:  
FROM LAKE KOOCANUSA, TAKE CRIPPLE HORSE ROAD TO FS RD 6790, STAYING TO  
RIGHT AT THE FORK. THEN TURN LEFT AT THE NEXT FORK. PARK JUST AFTER  
FORK AND WALK TOWARD CREEK.

Element occurrence data:  
7 PLANTS FOUND, 100% PRODUCING SPORES.

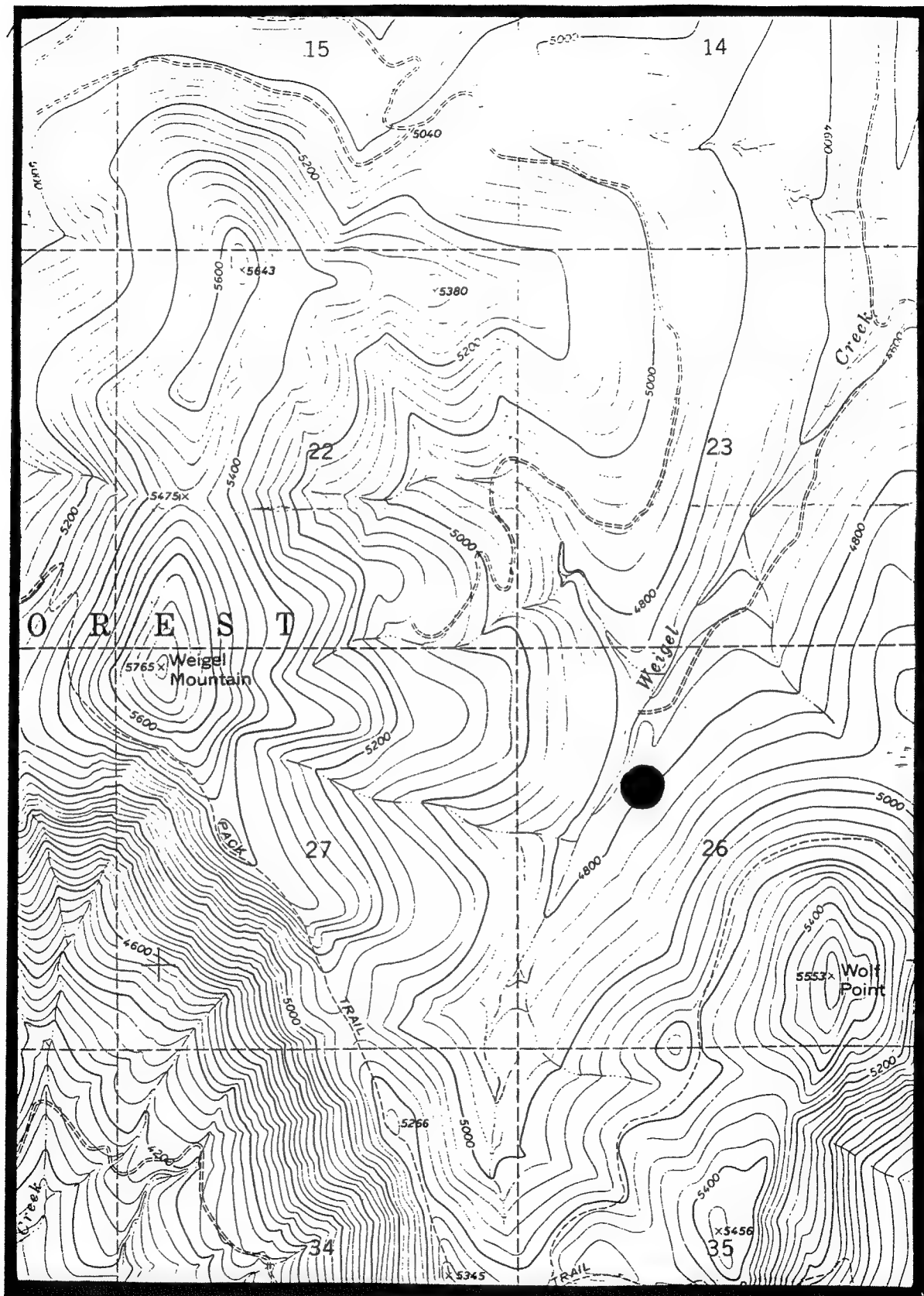
General site description:  
FLOOD PLAIN OF WET CREEK BOTTOM IN PARTIAL SUN. ASSOCIATED PLANT  
SPECIES INCLUDE: ABIES LASIOCARPA, EQUISETUM SPP., SMILACINA STELLATA,  
GYMNOCARPIUM DRYOPTERIS, RIBES LACUSTRE, GLYCERIA SPP., ALNUS SPP.  
ADDITIONAL ASSOCIATED SPECIES INCLUDE PLATANATHERA STRICTA (HABENARIA  
SACCATA), SENECIO TRIDENTATA, BROMUS SPP., HERACLEUM LANATUM, VIOLA  
CANADENSIS, VIOLA ORBICULATA, TIARELLA TRIDENTATA, MITELLA BREWERI AND  
GALIUM TRIFLORUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FISHER RIVER RANGER DISTRICT

Comments:  
OBSERVED BY T. BIELAK AND J. RENY. MUCH MOISTURE IN SPRING OF 1996.  
SIMILAR HABITAT EXISTS ALONG CREEK BOTTOM; STANDING WATER 15 FEET  
AWAY.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:



*Botrychium minganense*; Weigel Creek (054)  
USGS Warland Peak 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.055  
Element occurrence type:

Survey site name: WEIGEL MOUNTAIN  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: WARLAND PEAK

Township: Range: Section: TRS comments:  
031N 027W 21 NW4

Precision: S  
Survey date: Elevation: 4760 -  
First observation: 1996-08-28 Slope/aspect: 0-5% / NORTH  
Last observation: 1996-08-28 Size (acres): 1

Location:  
FROM LAKE KOOCANUSA TAKE CRIPPLE HORSE CREEK RD 835 TO SUMMIT SPRINGS  
RD 4905, CA. 1.5-2 MILES TO JUNCTION WITH RD 4951. TAKE RD 4951 0.15  
TO 0.25 MILE. AREA IS ON LEFT (EAST) TOWARD CREEK. POPULATION IS IN  
OPEN, GRASSY MEADOW WITH MEANDERING STREAM CHANNEL.

Element occurrence data:  
6 INDIVIDUALS, 100% PRODUCING SPORES.

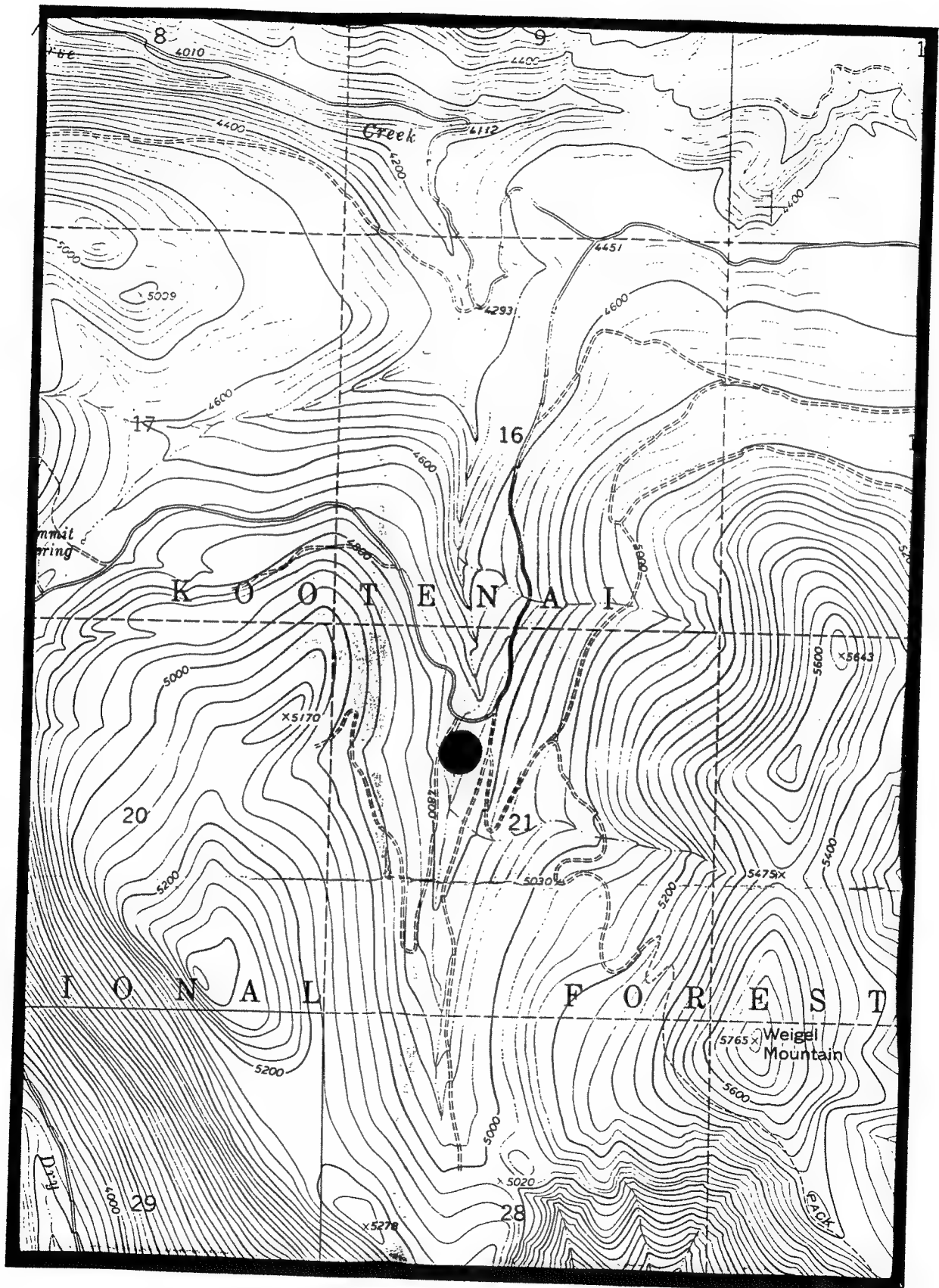
General site description:  
HUMMOCKY SEASONAL FLOODPLAIN IN PARTIAL SHADE. ASSOCIATED PLANT  
SPECIES INCLUDE: PICEA ENGELMANNII, POPULUS TREMULOIDES, ALNUS  
SINUATA, SYMPHORICARPOS ALBUS, ARNICA SPP., POA SPP. ADDITIONAL  
ASSOCIATED SPECIES INCLUDE: RUBUS IDAEUS, VIOLA GLABELLA, FRAGARIA  
VIRGINIANUS, SENEIO TRIDENTATA, GALIUM TRIFLORUM, SMILACINA STELLATA,  
ASTER LAEVIS, ANAPHALIS MARGARITACEA, TRILLIUM OVATUM, CORNUS  
CANADENSIS, PYROLA ASARIFOLIA, HERACLEUM LANATUM, ACONITUM  
COLUMBIANUM, GENTIANELLA AMARELLA, MITELLA NUDA, ACTAEA RUBRA,  
VERONICA ANAGALLIS-AQUATICA, BROMUS VULGARIS, CALAMAGROSTIS  
CANADENSIS, CAREX LENTICULARIS, EQUISETUM HYEMALE.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FISHER RIVER RANGER DISTRICT

Comments:  
SURVEYED BY T. BIELAK AND J. RENY. DRY STREAM CHANNEL NEARBY. AREA  
SUPPORTS EXTENSIVE HABITAT. DISTURBANCES INCLUDE GAME TRAILS AND BEDS;  
SOME BROWSING.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:



*Botrychium minganense*; Weigel Mountain (055)  
USGS Warland Peak 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4      Forest Service status: SENSITIVE  
State rank: S2S3      Federal Status:

Element occurrence code: PPOPH010R0.056  
Element occurrence type:

Survey site name: TURNER CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: LOST HORSE MOUNTAIN

Township: Range: Section: TRS comments:  
036N      031W      25      SW4

Precision: S  
Survey date: 1996-08-21      Elevation: 4300 -  
First observation: 1996-08-21      Slope/aspect: 5% / NORTHEAST  
Last observation: 1996-08-21      Size (acres): 1

Location:  
FROM VINAL LAKE (NEAR YAAK COMMUNITY CENTER) FOLLOW FS RD 6064 TO THE  
INTERSECTION WITH FS RD 6072. CONTINUE UP FS RD 6064 CA. 0.5 MILE. THE  
POPULATION IS BELOW THE ROAD (NORTHEAST) IN THE BOTTOM OF THE DRAW CA.  
100 YARDS FROM THE ROAD.

Element occurrence data:  
22 PLANTS OBSERVED - SPORES PRESENT.

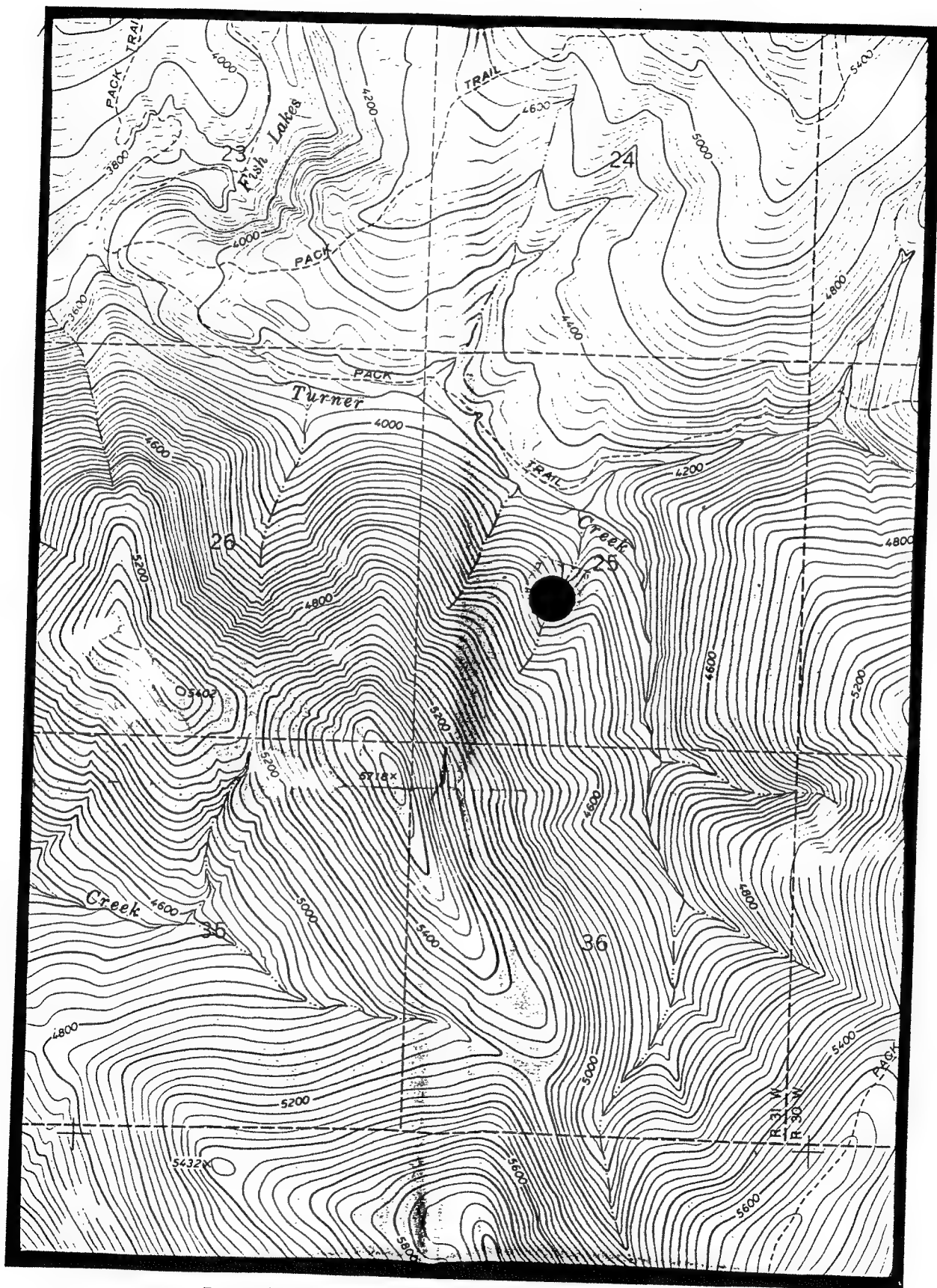
General site description:  
MOIST,, SHADED BOTTOM. ASSOCIATED PLANT SPECIES INCLUDE THUJA PLICATA,  
LARIX OCCIDENTALIS, TSUGA HETEROPHYLLA, CLINTONIA UNIFLORA,  
GYMNOCARPIUM DRYOPTERIS, TIARELLA TRIDENTATA, VIOLA GLABELLA,  
SMILACINA STELLATA, S. RACEMOSA, ACTAEA RUBRA, LISTERA CAURINA.  
ADDITIONAL PLANT ASSOCIATES INCLUDE: ATHRYIUM FILIX-FEMINA,  
CYSTOPTERIS FRAGILIS AND VIOLA ORBICULATA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY M. ARVIDSON. SOME HERBIVORY.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:



*Botrychium minganense*; Turner Creek (056)  
USGS Lost Horse Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4      Forest Service status: SENSITIVE  
State rank: S2S3      Federal Status:

Element occurrence code: PPOPH010R0.057  
Element occurrence type:

Survey site name: BASIN CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: ROBINSON MOUNTAIN

Township: Range: Section: TRS comments:  
036N      030W      09      SE4

Precision: S  
Survey date:      Elevation: 4160 -  
First observation: 1996-07-30      Slope/aspect: LEVEL  
Last observation: 1996-07-30      Size (acres): 3

Location:  
FROM CARIBOU CAMPGROUND ON EAST FORK YAAK RIVER, FOLLOW FS RD 337 UP  
BASIN CREEK FOR CA. 3 MILES. POPULATION IS CA. 200 FT. EAST OF THE  
ROAD ALONG THE STREAM THAT FLOWS THROUGH THE MIDDLE OF SECTION 9.

Element occurrence data:  
28 PLANTS OBSERVED, SCATTERED. FERTILE FRONDS AND SPORES DEVELOPED.

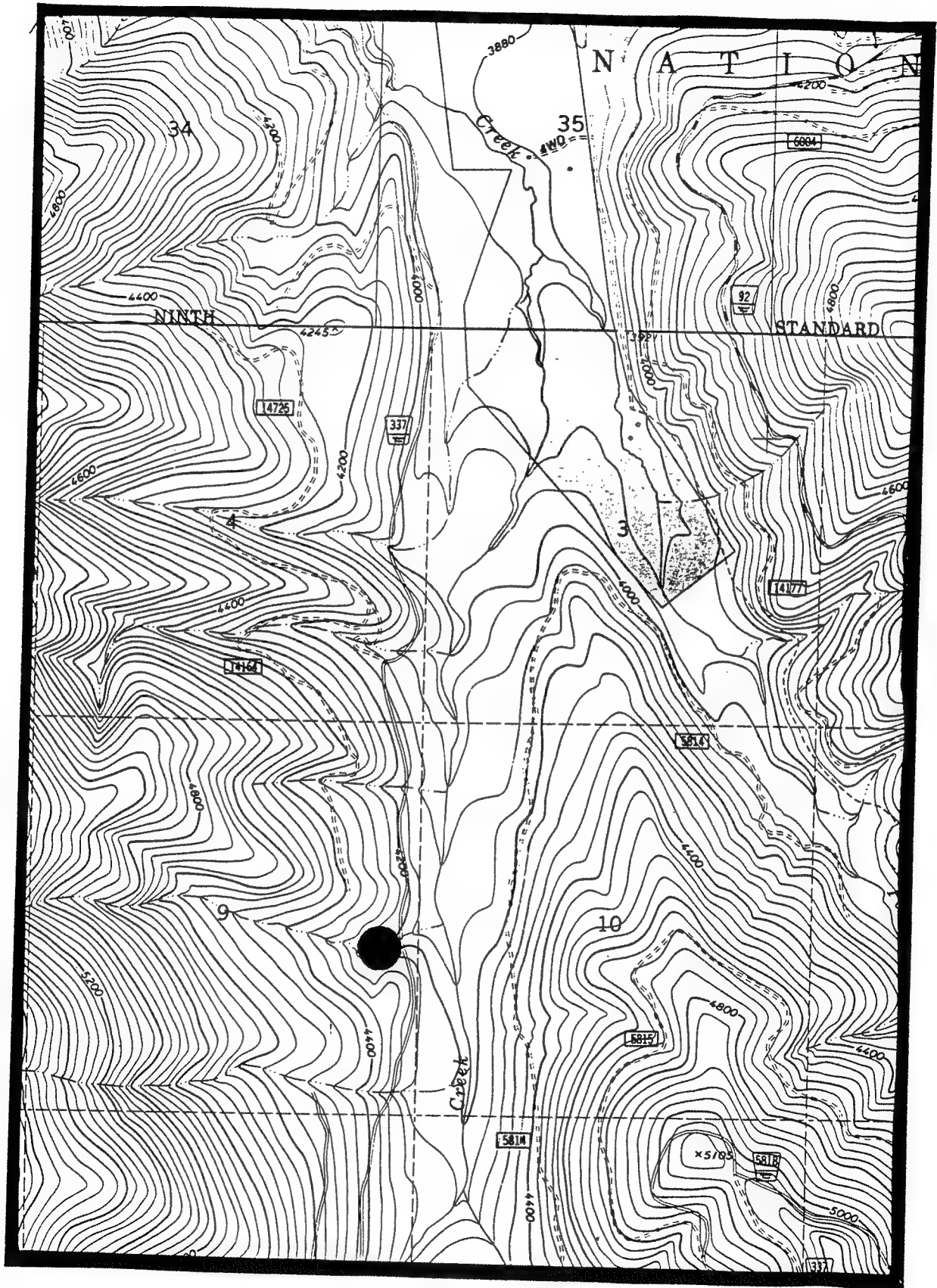
General site description:  
MOIST, SHADED BOTTOM SWALES, WITH THUJA PLICATA, LARIX OCCIDENTALIS,  
POPULUS TRICHOCARPA, CLINTONIA UNIFLORA, STREPTOPUS AMPLEXIFOLIUS,  
TIMMIA SPP., RHIZOMNIUM SPP., TIARELLA TRIDENTATA, PICEA ENGELMANNII,  
GYMNOCARPIUM DRYOPTERIS, LINNAEA BOREALIS, RUBUS PEDATUS, STENANTHIUM  
OCCIDENTALE.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY M. ARVIDSON.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:



*Botrychium minganense*; Basin Creek (057)  
USGS Robinson Mountain 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4      Forest Service status: SENSITIVE  
State rank: S2S3      Federal Status:

Element occurrence code: PPOPH010R0.058  
Element occurrence type:

Survey site name: PIPE CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: FLATIRON MOUNTAIN

Township: Range: Section: TRS comments:  
033N      031W      8      SW4

Precision: S  
Survey date:      Elevation: 3360 - 3400  
First observation: 1996-08-13      Slope/aspect: LEVEL  
Last observation: 1996-08-13      Size (acres): 1

Location:  
FROM LIBBY, GO NORTH ON HWY 68 (PIPE CREEK ROAD) CA. 16 MILES. SITE IS  
EAST OF HWY 68 IN SOUTHWEST CORNER OF SECTION 8. SITE IS AN OUTWASH  
CHANNEL UPSTREAM ON THE WEST BANK OF PIPE CREEK.

Element occurrence data:  
1 INDIVIDUAL WITH FRUIT.

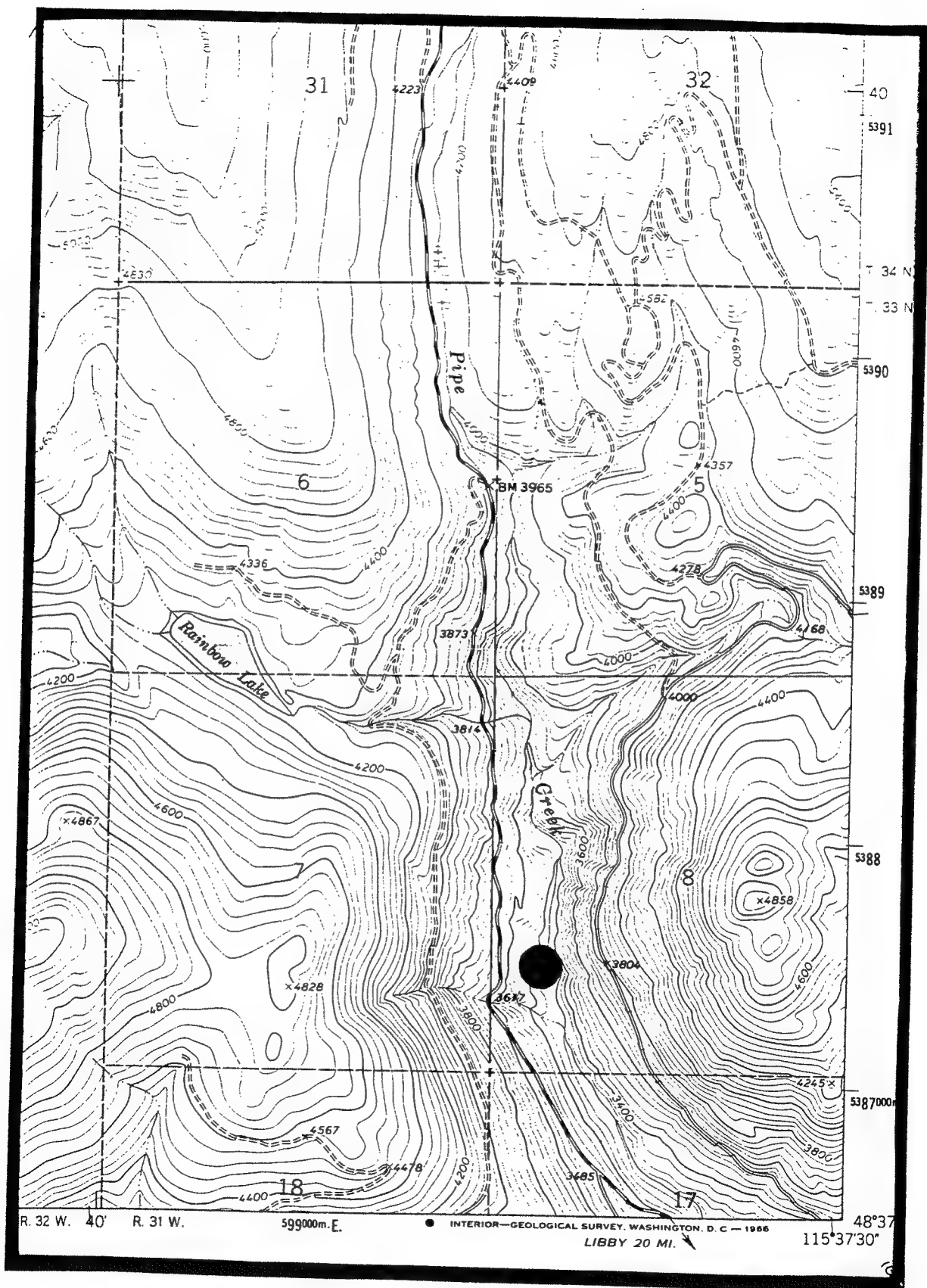
General site description:  
MOSSY AND MOIST OPEN MICROSITE SEVERAL FEET FROM WATER WITH THICK  
ORGANIC LAYER. SILT-GRAVELLY SILT LOAM, LOESS BEDROCK PARENT MATERIAL.  
ASSOCIATED SPECIES: THUJA PLICATA, LARIX OCCIDENTALIS, ABIES  
LASIOCARPA, ACER GLABRUM, TAXUS BREVIFOLIA, CORNUS STOLONIFERA,  
OPLOPAX HORRIDUM, RIBES LACUSTRE, RUBRUS PARVIFLORUS, ROSA SPP.,  
STREPTOPUS AMPLEXIFOLIUS, ACONITUM COLUMBIANUM, GALIUM TRIFLORUM,  
MITELLA NUDA, SMILACINA STELLATA, TIARELLA TRIFOLIATA, VIOLA GLABELLA,  
GLYCERIA, GYMNOCARPIUM DRYOPTERIS, ATHYRIUM FILIX-FEMINA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
OBSERVED BY THERESE BIELAK. HABITAT EXTENDS FOR CA. 0.5 ACRES, BUT  
ONLY ONE INDIVIDUAL OBSERVED.

Information source: BOTANIST, MONTANA NATURAL HERITAGE PROGRAM, 1515  
EAST SIXTH AVENUE, HELENA, MT 59620-1800.

Specimens:



*Botrychium minganense*; Pipe Creek (058)  
USGS Flatiron Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.059  
Element occurrence type:

Survey site name: PARSNIP CREEK  
EO rank: A  
EO rank comments: EXCELLENT, DIVERSE GENUS COMMUNITY.

County: LINCOLN

USGS quadrangle: INCH MOUNTAIN

Township: Range: Section: TRS comments:  
034N 029W 34 SW4

Precision: S  
Survey date: 1996-09-20 Elevation: 2640 - 2680  
First observation: 1996-09-20 Slope/aspect: LEVEL  
Last observation: 1996-09-20 Size (acres): 10

Location:  
GO NORTH ON FS RD 228 ALONG WEST SIDE OF LAKE KOOCANUSA CA. 35 MILES  
OUT OF LIBBY. FROM FS RD 228, GO UP FS RD 4838 CA. 200 YARDS TO SPUR  
ROAD. PLANTS IN CREEK BOTTOM BELOW SPUR ROAD.

Element occurrence data:  
50+ INDIVIDUALS; SENESCENT, POST SPORE RELEASE.

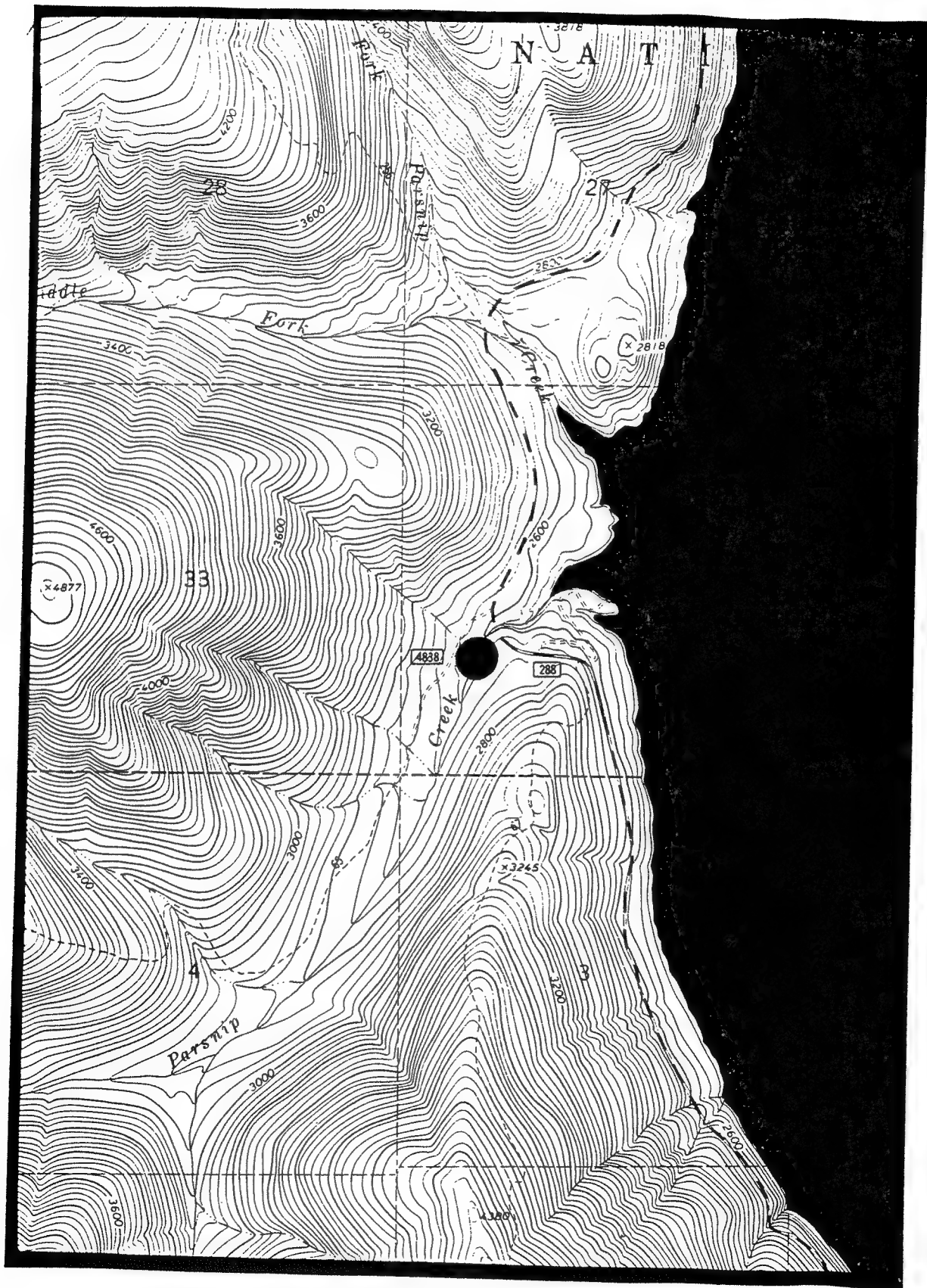
General site description:  
MOIST, SHADY BOTTOM IN A FLOODPLAIN. SOIL IS TWO INCH DUFF OVER  
SILT/DUFF LAYERS OVER ALLUVIUM. THUJA PLICATA/ATHYRIUM FILIX-FEMINA  
HT, WITH PICEA, PSEUDOTSUGA MENZIESII, LARIX OCCIDENTALIS, BETULA  
PAPYRIFERA, TIARELLA TRIFOLIATA, CLINTONIA UNIFLORA, BOTRYCHIUM  
PEDUNCULOSUM, B. MONTANUM, B. LANCEOLATA, B. VIRGINIANUM, THELYPTERIS  
PHEGopteris.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
OBSERVED BY JIM VANDERHORST AND ANNIE DEUKER. DRAINAGE IS PROPOSED FOR  
LOGGING AND NEW ROADS IN UPLANDS, INCREASED RUNOFF COULD CAUSE  
FLOODING WHICH COULD AFFECT POPULATION.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5636). 1996. MONTU.



*Botrychium minganense*; Parship Creek (059)  
USGS Inch Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4      Forest Service status: SENSITIVE  
State rank: S2S3      Federal Status:

Element occurrence code: PPOPH010R0.060  
Element occurrence type:

Survey site name: BIG CREEK  
EO rank: B  
EO rank comments: FEW PLANTS WITH HIGH VIGOR, SMALL REMNANT OLD  
GROWTH.

County: LINCOLN

USGS quadrangle: BOULDER LAKES

Township: Range: Section: TRS comments:  
035N      030W      35      NW4

Precision: S  
Survey date: 1996-08-09      Elevation: 3040 - 3160  
First observation: 1996-08-09      Slope/aspect: LEVEL  
Last observation: 1996-08-09      Size (acres): 1

Location:  
FROM EUREKA, GO WEST ON HWY 37 CA. 10 MILES, CROSS LAKE KOOCANUSA, AND  
GO SOUTH ON HWY 228 CA. 7 MILES AND TURN WEST ONTO FS RD 336. TRAVEL  
UP BIG CREEK ON 336 CA. 5 MILES TO GOOD CREEK CROSSING. WALK WEST CA.  
1 MILE. POPULATION IS IN OLD GROWTH CEDAR ON SOUTH SIDE OF CREEK.

Element occurrence data:  
CA. 10 PLANTS WITH ALMOST MATURE SPORANGIA.

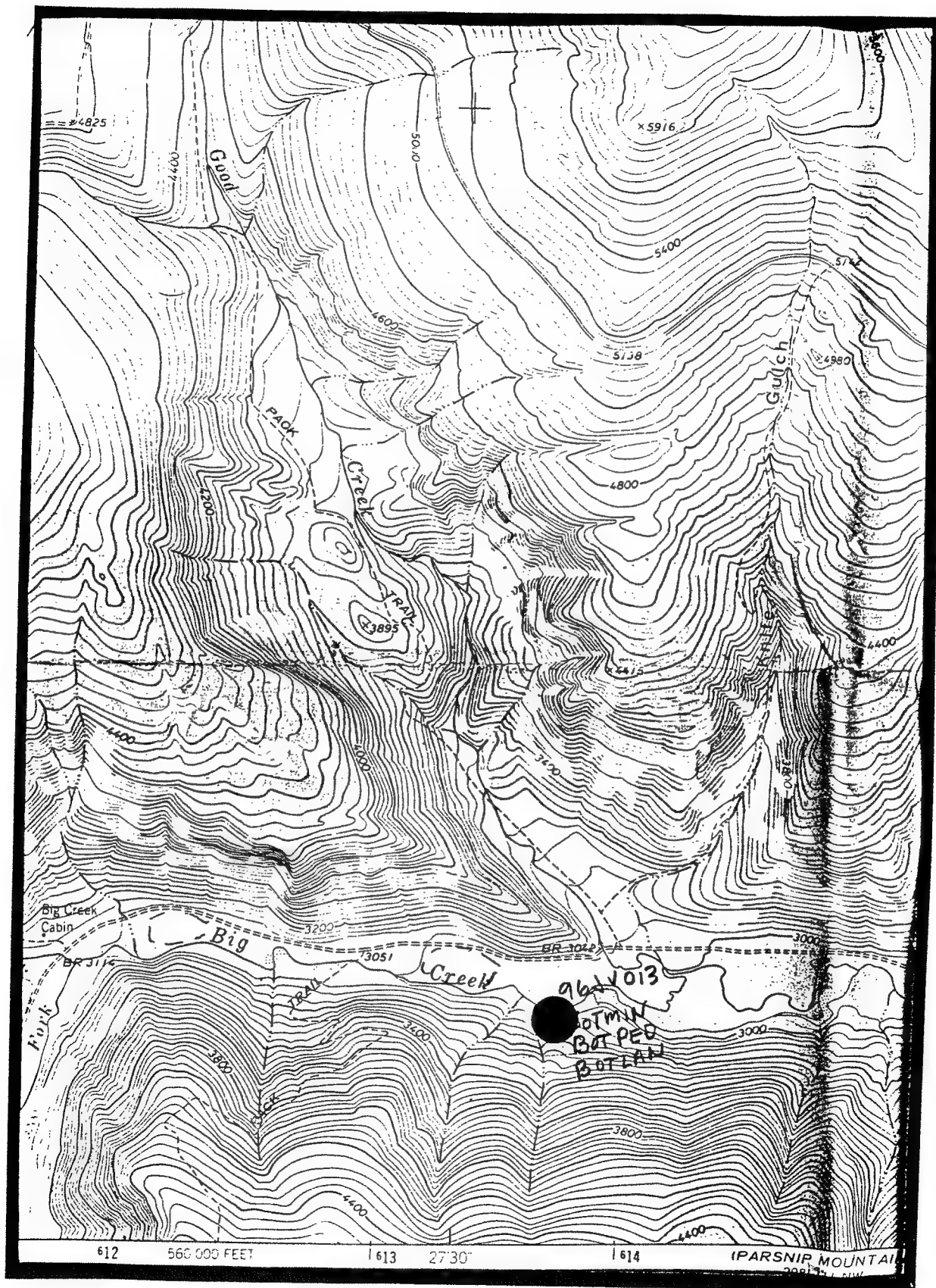
General site description:  
SHADY, MOIST BOTTOM IN A FLOODPLAIN. SOIL IS 2 INCH LITTER OVER SILTY  
ALLUVIUM. THUJA PLICATA/OPLOPANAX HORRIDUM HT, WITH CLINTONIA  
UNIFLORA, PICEA, PSEUDOTSUGA MENZIESII, ACER GLABRUM, TIARELLA  
TRIFOLIATA, CIRCEA ALPINA, GYMNOCARPIUM DRYOPTERIS, BOTRYCHIUM  
VIRGINIANUM, BOTRYCHIUM LANCEOLATUM, BOTRYCHIUM PEDUNCULOSUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
OBSERVED BY JIM VANDERHORST. ECODATA PLOT # FSO1140196JV013.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



*Botrychium minganense*; Big Creek (060)  
USGS Boulder Lakes 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.061  
Element occurrence type:

Survey site name: UPPER WEIGEL CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: WARLAND PEAK

Township: Range: Section: TRS comments:  
032N 027W 33 NW4SE4

Precision: S  
Survey date: Elevation: 5080 - 5200  
First observation: 1996-07-23 Slope/aspect: 05% / EAST  
Last observation: 1996-07-23 Size (acres): 2

Location:

FROM LIBBY, GO NORTHEAST ON HWY 37 CA. 20 MILES TO CRIPPLE HORSE ROAD  
(FS RD 835). GO CA. 11 MILES EAST ON 835, THEN TURN LEFT ON LAKE CREEK  
ROAD (FS RD 4424) AND GO CA. 2 MILES. JUST PAST THE J SPUR HEAD WEST  
UP CREEK.

Element occurrence data:  
3 INDIVIDUALS; ALL IN FLOWER.

General site description:

SITE IS ALONG A FLAT, MOSSY, AND WET BANK OF A BARELY TRICKLING  
STREAM. STREAM IS SCOURED. AREA IS PARTLY SUNNY OVER SOIL THAT IS  
GRAVELLY SILT LOAM. A LONE INDIVIDUAL IS DOWNSTREAM (EAST) GROWING IN  
AN ABANDONED STREAM CHANNEL AMONG MOSS UNDER ALDER. THIS SITE IS BY AN  
ADJACENT CLEARCUT. ASSOCIATED PLANTS: PICEA ENGELMANNII, ABIES  
LASIOCARPA, ALNUS SINUATA, SYMPHORICARPOS ALBUS, ATHYRIUM  
FILIX-FEMINA, GYMNOCARPIUM DRYOPTERIS, EQISETUM, ACTAED RUBRA,  
CLINTONIA UNIFLORA, HABENARIA SACCATA, HERACLEUM LANATUM, OSMORHIZA  
CHILENSIS, PYROLA SECUNDA, SENECIO TRIANGULARIS, SMILACINA STELLATA,  
VIOLA GLABELLA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FISHER RIVER RANGER DISTRICT

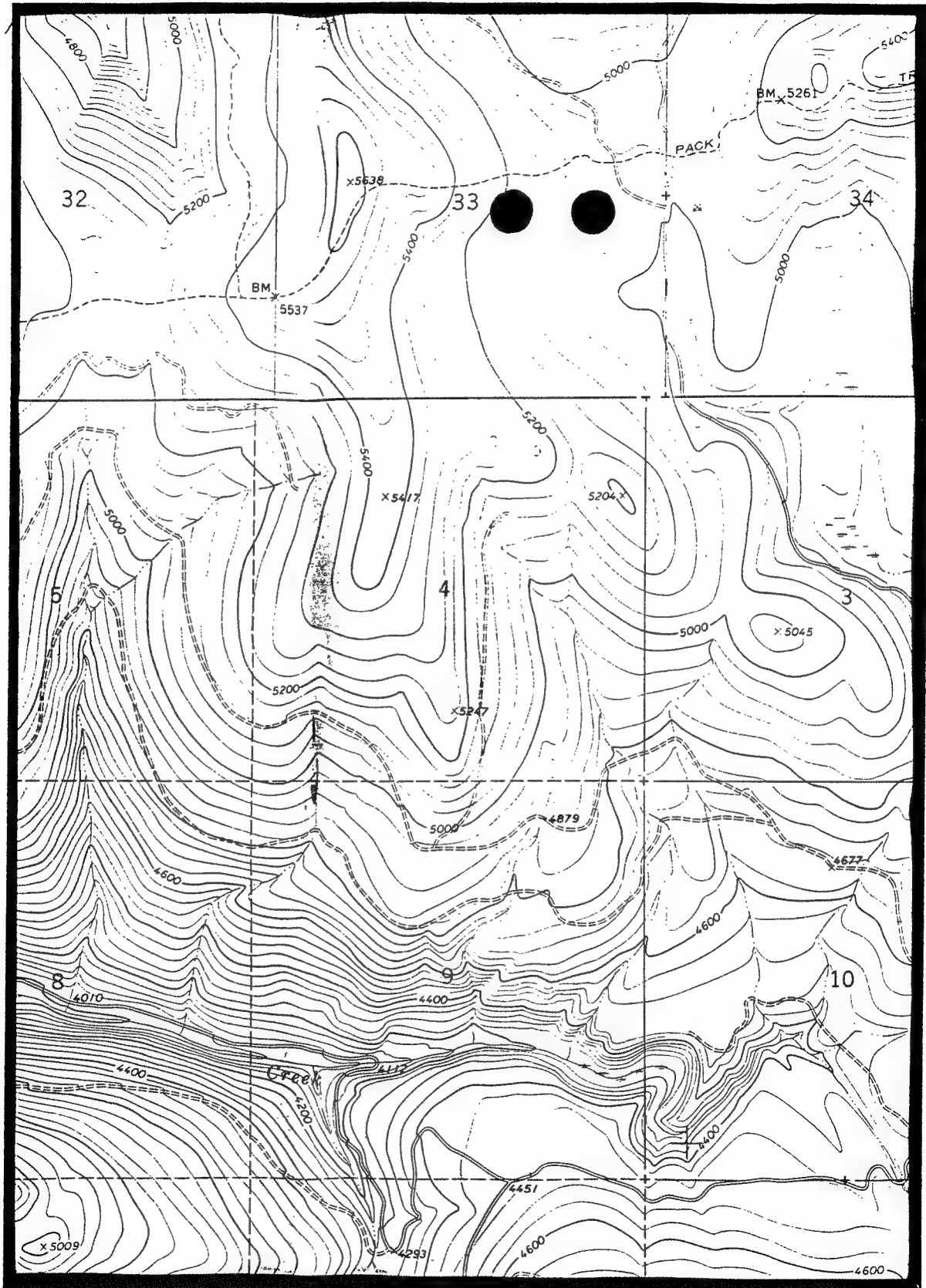
Comments:

OBSERVED BY T. BIELAK AND J. RENY. LEGAL DESCRIPTION AND ELEVATION  
WERE INCONSISTENT WITH THE MAP PROVIDED; MAPPED LOCATION ASSUMED TO BE  
CORRECT.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:





*Botrychium minganense*; Upper Weigel Creek (061)  
USGS Warland Peak 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.063  
Element occurrence type:

Survey site name: UPPER TURNER CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: LOST HORSE MOUNTAIN

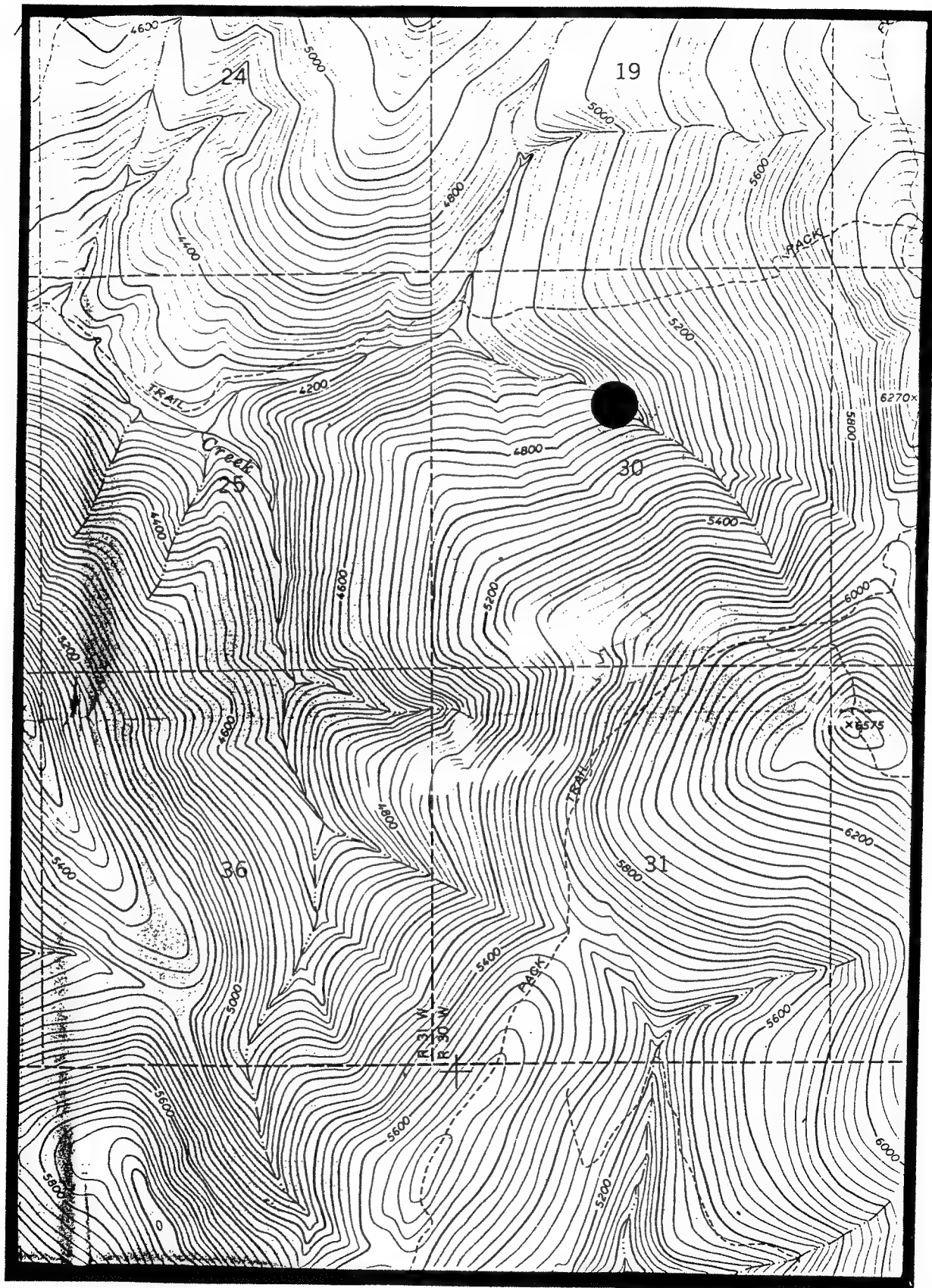
Township: Range: Section: TRS comments:  
036N 030W 30 SW4NW4  
Precision: S Survey date: Elevation: 4680 - 4820  
First observation: 1996-08-07 Slope/aspect: 0-5% / LOW RELIEF  
Last observation: 1996-08-07 Size (acres): 1

Location:  
FROM VINAL LAKE (NEAR YAAK COMMUNITY CENTER) FOLLOW FS RD 6064 TO THE  
INTERSECTION WITH FS RD 14700. CONTINUE UP FS RD 14700 TO WHERE IT  
CROSSES TURNER CREEK AND FOLLOW THE HIKING TRAIL TO ABOUT HALF THE  
DISTANCE BETWEEN ROADS 14700 AND 6064. THE POPULATION IS BOTH NEAR THE  
STREAM AND CA. 100 YARDS SOUTHWEST FROM THE TRAIL.

Element occurrence data: NINETEEN PLANTS OBSERVED, SPORES PRESENT.

General site description: MOIST, SHADED BOTTOM. ASSOCIATED PLANT SPECIES INCLUDE THUJA PLICATA,  
ABIES LASIOCARPA, POPULUS TREMULOIDES, TSUGA HETEROPHYLLA, PSEUDOTSUGA MENZIESII,  
GYMNOCARPIMUM DRYOPTERIS, ATHYRIUM FILIX-FEMINA, TIARELLA TRIDENTATA, CLINTONIA  
UNIFLORA, ACTAEA RUBRA, GALIUM TRIFLORUM. ADDITIONAL PLANT ASSOCIATES INCLUDE LISTERA  
CAURINA, ARNICA LATIFOLIA, OPLOPANAX HORRIDUM, BOTRYCHIUM MONTANUM.  
Land owner/manager: KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT  
Comments: OBSERVED BY MICHAEL ARVIDSON. SOME MINOR HERBIVORY.  
Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:



*Botrychium minganense*; Upper Turner Creek (063)  
USGS Lost Horse Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.064  
Element occurrence type:

Survey site name: NORTH FORK MEADOW CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: MOUNT BALDY

Township: Range: Section: TRS comments:  
035N 034W 11 SW4, SE4; 14 NE4, NW4; 13 NW4

Precision: S  
Survey date: Elevation: 3780 - 4760  
First observation: 1996-09-23 Slope/aspect: 0-10% / NORTHEAST  
Last observation: 1996-09-23 Size (acres): 3

Location:  
CA. 11 AIR MILES WEST OF YAAK. ALL 6 SUBPOPULATIONS ARE LOCATED UP  
NORTH FORK MEADOW CREEK. ACCESS VIA FS RD 5961.

Element occurrence data:  
37 PLANTS OBSERVED IN 6 SUBPOPULATIONS. SPORES PRESENT.

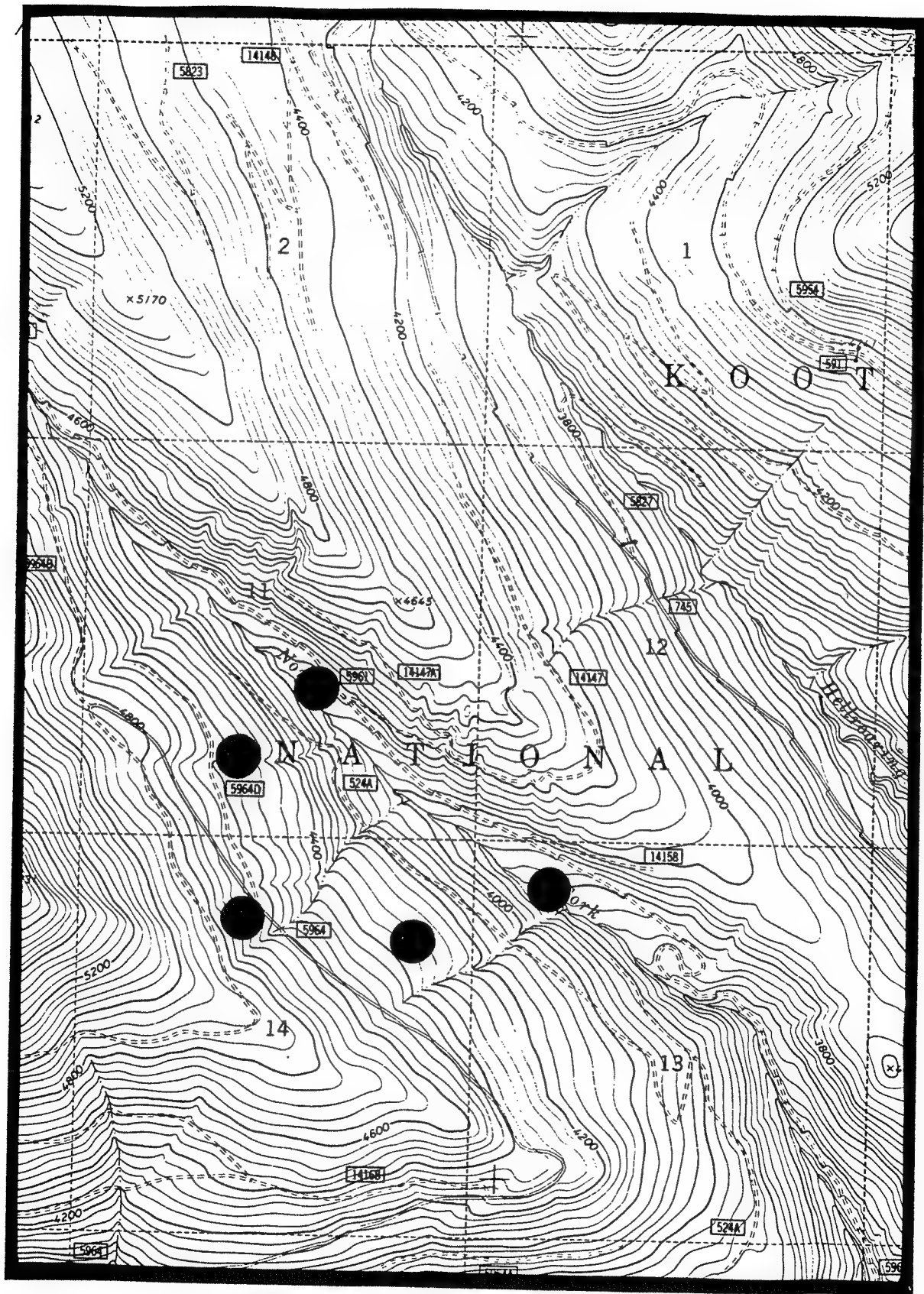
General site description:  
MOIST, SHADED BOTTOM, WITH THUJA PLICATA, TSUGA HETEROPHYLLA, PINUS  
MONTICOLA, ABIES BIFLORA, LARIX OCCIDENTALIS, CLINTONIA UNIFLORA,  
PYROLA SECUNDA, TIARELLA TRIDENTATA, GOODYERA OBLONGIFOLIA, ACTAEA  
RUBRA, OPILOPANAX HORRIDUM, VACCINIUM MEMBRANACEUM, MENZIESIA  
FERRUGINEA, BOTRYCHIUM LANCEOLATUM, ATHYRIUM FILIX-FEMINA, DRYOPTERIS  
AUSTRIACA, LYCOPODIUM ANNOTINUM, HYPERZIA OCCIDENTALIS, GYMNOCARPIUM  
DRYOPTERIS.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY M. ARVIDSON.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:



*Botrychium minganense*; North Fork Meadow Creek (064)  
USGS Mount Baldy 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.065  
Element occurrence type:

Survey site name: ARBO CREEK  
EO rank: C  
EO rank comments: SMALL POPULATION.

County: LINCOLN

USGS quadrangle: SYLVANITE

Township: Range: Section: TRS comments:  
033N 033W 14 NW4

Precision: S  
Survey date: 1996-08-14 Elevation: 3780 -  
First observation: 1996-08-14 Slope/aspect: LEVEL  
Last observation: 1996-08-14 Size (acres): 5

Location:  
SOUTH OF YAAK FALLS ON ARBO CREEK. FROM EAST SIDE ROAD (FS RD 176)  
FOLLOW FS ROAD 2367 CA. 2.5 MILES TO SPUR ROAD WHICH CROSSES ARBO  
CREEK. POPULATION IS UPSTREAM AND DOWNSTREAM FROM BRIDGE.

Element occurrence data:  
CA. 20 PLANTS OBSERVED, 100% WITH MATURE SPORANGIA, SPORES BEING  
RELEASED.

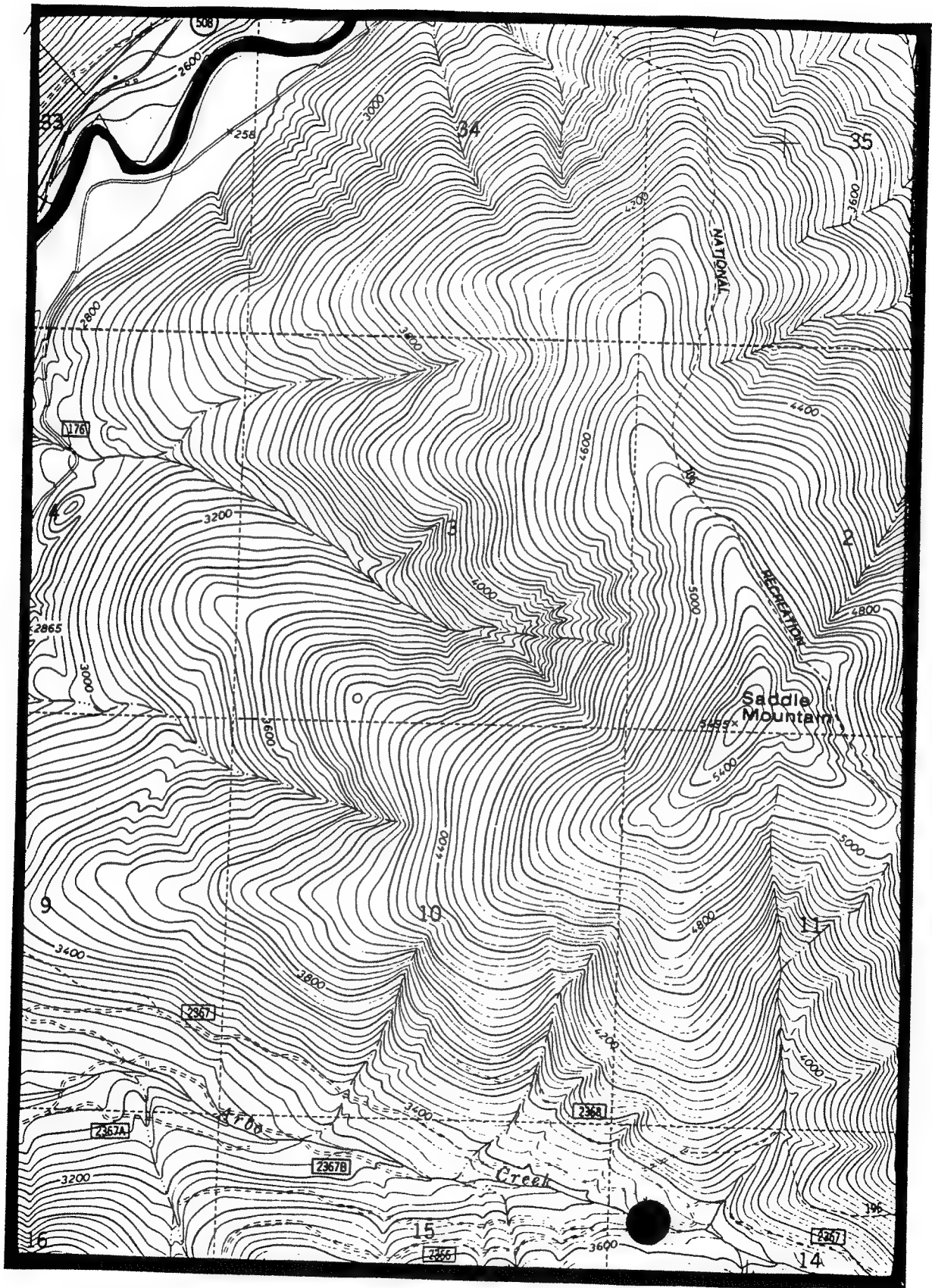
General site description:  
MOIST, SHADED BOTTOM, ORGANIC LAYER OVER GLACIAL ALLUVIUM. ASSOCIATED  
PLANTS INCLUDE THUJA PLICATA, TSUGA HETEROPHYLLA, OPILODENDRON HORRIDUM,  
CLINTONIA UNIFLORA. ADDITIONAL PLANT ASSOCIATES INCLUDE PSEUDOTSUGA  
MENZIESII, GYMNOCARPIUM DRYOPTERIS, TIARELLA TRIFOLIATA, RHYTHIDOPSIS  
ROBUSTA, SMILACINA STELLATA, ORTHILLIA SECUNDA, DRYOPTERIS DILATATA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY JIM VANDERHORST. POPULATION SURROUNDED BY CLEARCUTS AND  
ROADS; STREAM BOTTOM SELECTIVELY LOGGED IN PAST. SOME HERBIVORY  
OBSERVED.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



*Botrychium minganense*; Arbo Creek (065)  
USGS Sylvanite 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.066  
Element occurrence type:

Survey site name: OTHORP-MORGAN LAKE  
EO rank: D  
EO rank comments: SITE HEAVILY GRAZED AND TRAMPLED; POOR POPULATION.

County: LINCOLN

USGS quadrangle: EUREKA SOUTH

Township: Range: Section: TRS comments:  
036N 027W 33 NE4NE4

Precision: S  
Survey date: 1996-08-08 Elevation: 3080 -  
First observation: 1996-08-08 Slope/aspect: 3% / NORTHEAST  
Last observation: 1996-08-08 Size (acres): 1

Location:  
CA. 2.5 AIR MILES SOUTHWEST OF EUREKA, BETWEEN MORGAN AND OTHORP  
LAKES. ACCESS VIA FS RD 7166.

Element occurrence data:  
5 PLANTS, SPORES DISPERSED. MYCORRHIZAL RELATIONSHIP. MORPHOLOGY OF  
PLANTS ATYPICAL; POSSIBLY SPECIES NOVUM.

General site description:  
POTHOLE IN OPEN BOTTOM, ALLUVIUM PARENT. HEAVILY-GRAZED ASSOCIATION OF  
EXOTIC GRASSES AND FORBS, WITH AGROSTIS STOLONIFERA, POA PRATENSIS,  
ANTENNARIA MICROPHYLLA, MEDICAGO LUPULINA, CAREX AUREA, VIOLA ADUNCA,  
ANEMONE MULTIFIDA, POTENTILLA ANSERINA.

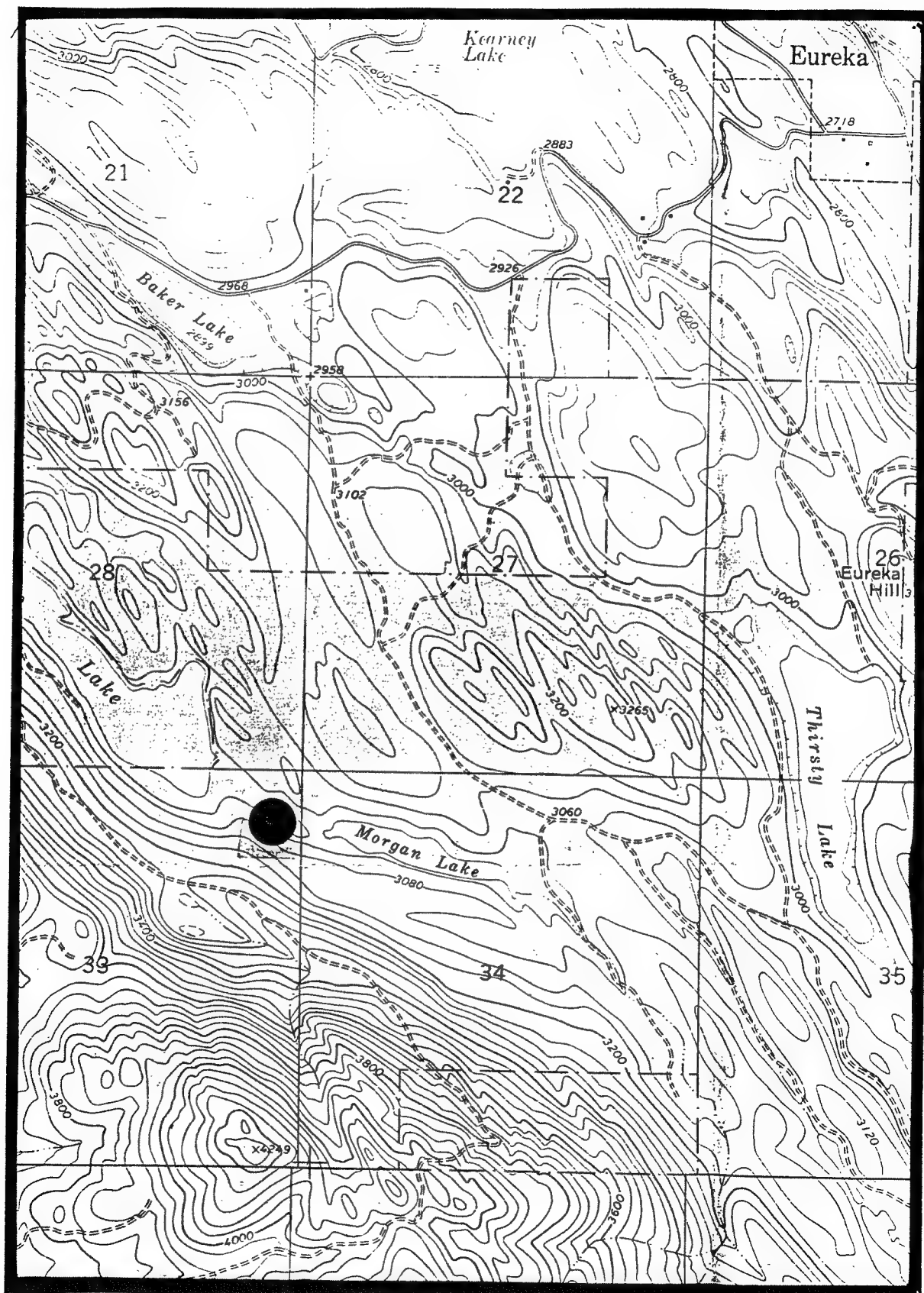
Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT  
KOOTENAI NATIONAL FOREST, FORTINE RANGER DISTRICT

Comments:  
LAKESHORE LOGGED BY EARLY HOMESTEADERS, CONVERTED TO COW PASTURE. W.H.  
WAGNER STATED THAT PLANTS COULD BE SP. NOV "BOTRYCHUM SUBLUNARIA."  
POPULATION ON BORDER OF REXFORD AND FORTINE RANGER DISTRICTS.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5616). 1996. MONTU.





*Botrychium minganense*; Othorp-Morgan Lakes (066)  
USGS Eureka South 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MINGANENSE  
Common Name: MINGAN ISLAND MOONWORT

Global rank: G4 Forest Service status: SENSITIVE  
State rank: S2S3 Federal Status:

Element occurrence code: PPOPH010R0.067  
Element occurrence type:

Survey site name: STERLING CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: DAVIS MOUNTAIN

Township: Range: Section: TRS comments:  
033N 027W 16 SW4

Precision: S  
Survey date: Elevation: 4640 - 4800  
First observation: 1996-09-16 Slope/aspect: 17% / NE  
Last observation: 1996-09-16 Size (acres):

Location:  
FROM LIBBY, TAKE HWY 37 CA. 20 MILES, TURN ONTO FS RD 835 CA. 13  
MILES, THEN FS RD 36 CA. 9 MILES, WEST ON FS RD 48 CA. 4 MILES, THEN  
CA. 3 MILES ON FS RD 3562. ABOVE FS RD 3562-B ON NORTHEAST-FACING  
SLOPE.

Element occurrence data:  
<20 SPORULATED PLANTS. TWO SUBPOPULATIONS. PLANTS TEND TO BE  
WEAK-STEMMED.

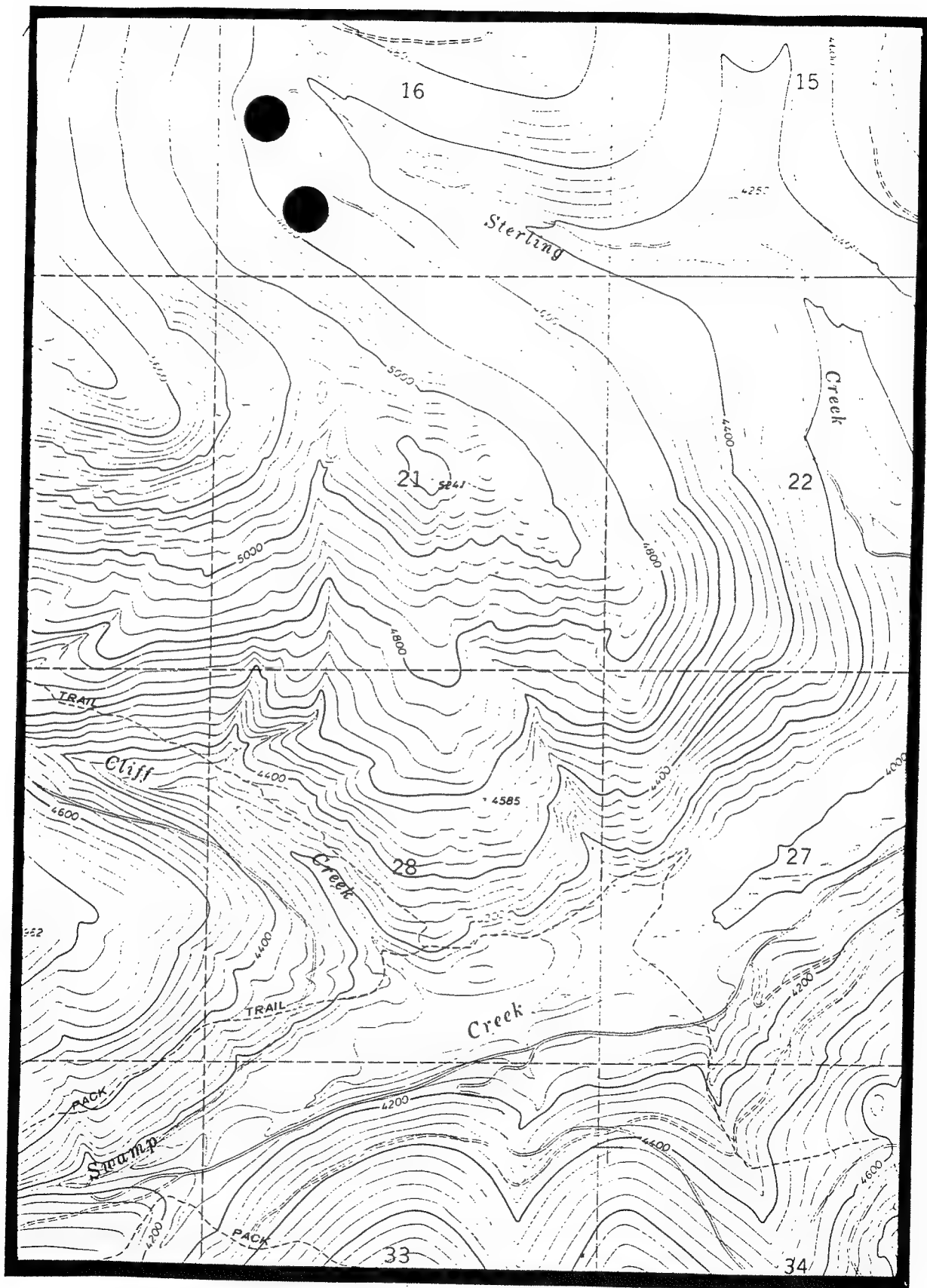
General site description:  
SHADED SITE IN OLD-GROWTH CEDAR FOREST; SILICATES PARENT MATERIAL.  
PLANTS RESTRICTED TO VERNAL FLUSHES DOMINATED BY OPLOPANAX HORRIDUM  
AND ATHYRIUM FILIX-FEMINA. THUJA PLICATA/OPLOPANAX HORRIDUM HT, WITH  
ROELLIA ROELLII AND BOTRYCHIUM MONTANUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FORTINE RANGER DISTRICT

Comments:  
OBSERVED BY T. SPRIBILLE. ECODATA PLOT #: FS01140396TS315. HEAVY  
UNGULATE USE OF AREA.

Information source: SPRIBILLE, TOBY. BOX 2106, COLUMBIA FALLS, MONTANA  
59912.

Specimens: SRRIBILLE, T. (S.N.). 1996. KOOTENAI NF, FORTINE  
DISTRICT HERBARIUM.



*Botrychium minganense*; Sterling Creek (067)  
USGS Davis Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010K0.009  
Element occurrence type:

Survey site name: UPPER CAN CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: LOST HORSE MOUNTAIN  
PINK MOUNTAIN

Township: . Range: Section: TRS comments:  
035N 031W 33 SW4; 32 SE4

Precision: S  
Survey date: Elevation: 4280 - 4680  
First observation: 1993-07-30 Slope/aspect: - / SW  
Last observation: 1996-08-13 Size (acres): 5

Location:  
CA. 6 MILES SOUTHEAST OF YAAK. FOLLOW SOUTH FORK YAAK RIVER (STATE HWY 508) TO ITS CONFLUENCE WITH CAN CREEK. SITE IS JUST ABOVE END OF CAN CREEK.

Element occurrence data:  
1996: 24 PLANTS IN SW SUBPOPULATION. 1995: 2 SUBPOPULATIONS, 35+5 PLANTS. 1993: 10-15 PLANTS, 1 SUBPOPULATION, ALL WITH SPOROPHORES.

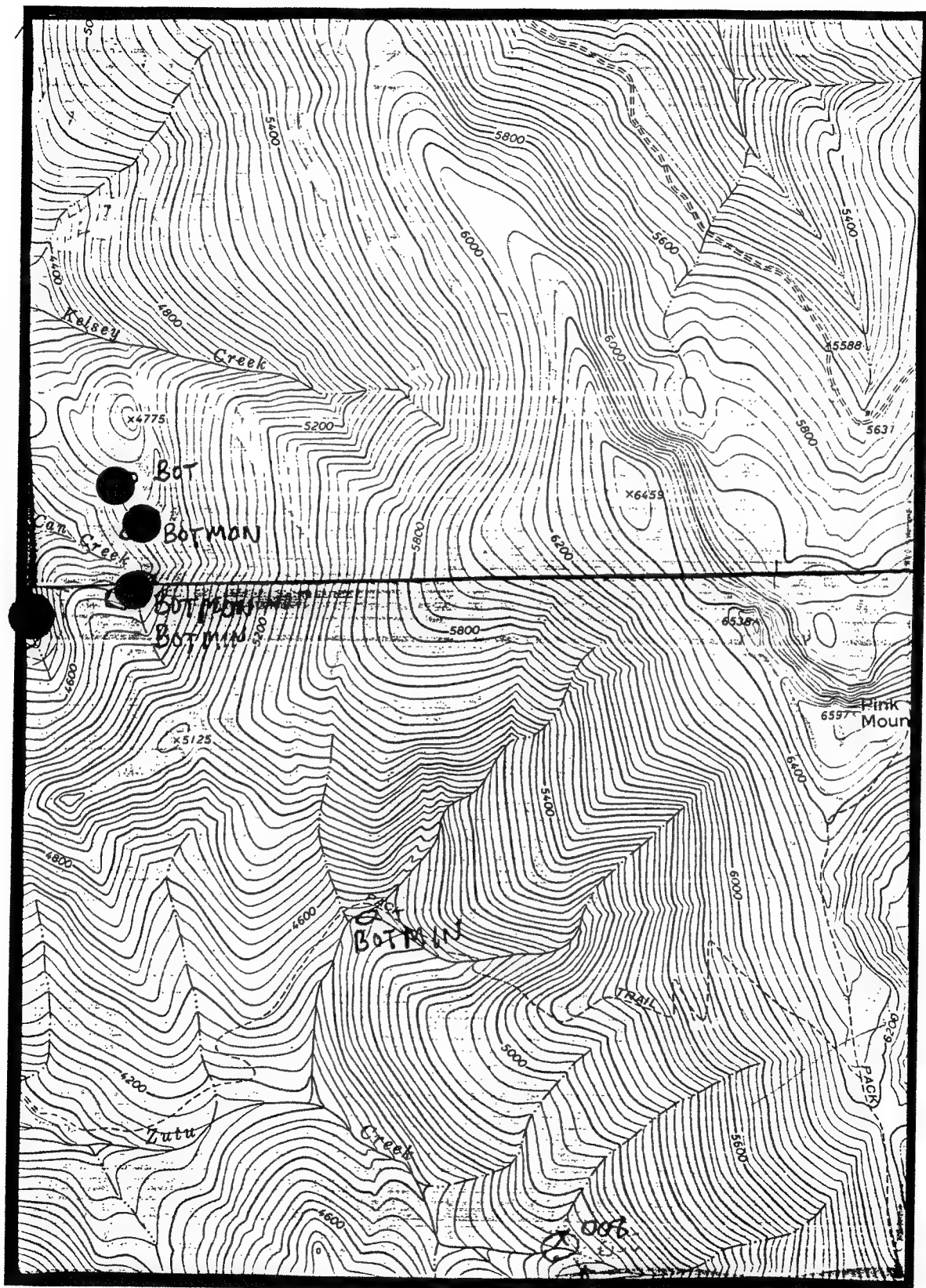
General site description:  
MOIST, SHADED UPPEXSLOPE DRAW BOTTOM. LANDTYPE 352. WESTERN RED CEDAR OVERSTORY. GENUS COMMUNITY MADE UP OF B. MINGANENSE, B. MONTANUM AND 1 PLANT OF B. PARADOXUM, WITH RIBES LACUSTRE, BERBERIS REPENS, ASTER SPP., ROSA GYMNOCARPA, VIOLA ORBICULATA, LINNAEA BOREALIS, SPIRAEA BETULIFOLIA, VACCINIUM SCOPARIUM, CHIMAPHILA UMBELLATA, LONICERA UTAHENSIS, SMILACINA STELLATA, OSMORHIZA CHILENSIS. COMPLETE LIST ON MILE AT MTNHP.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST IN 1996 AND 1995; BY L. FERGUSON IN 1993. NEW SUBPOPULATIONS FOUND IN 1995 BY VANDERHORST. SPECIMEN PHOTOCOPY VERIFIED BY P. ZIKA. ECODATA PLOT FS01140496JV016.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY, MT 59935.

Specimens: VANDERHORST, J. (5508, 5544). 1995. MONTU.



*Botrychium montanum*; Upper Can Creek (009)  
USGS Lost Horse Mountain and Pink Mountain 7.5' quadrangles

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010K0.011  
Element occurrence type:

Survey site name: CAN CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: FLATIRON MOUNTAIN

Township:	Range:	Section:	TRS comments:
035N	031W	32	SW4
034N	031W	5	NW4

Precision:	S	
Survey date:		Elevation: 3720 - 3840
First observation:	1993-07-29	Slope/aspect: 0% / WNW
Last observation:	1995-09-05	Size (acres): 3

Location:

CA. 1.8 AIR MILES NORTHEAST OF CLAY MOUNTAIN ON SOUTH SIDE OF CAN CREEK, CA. 0.5 MILE FROM MOUTH. SITE IS OFF PIPE CREEK ROAD.

Element occurrence data:

1995: CA. 100-200 PLANTS OF B. MONTANUM AND B. MINGANENSE. 1993: 70-100 PLANTS. SEVERAL SUBPOPULATIONS, SEVERAL SPECIES. ALL WITH SPOROPOHORES.

General site description:

IN GENUS COMMUNITY MADE UP OF B. MINGANENSE, B. MONTANUM, AND 1 PLANT OF B. PARADOXUM. MOIST, SHADED LOWERSLOPE/BOTTOM. LANDTYPE 352. OLD GROWTH WESTERN RED CEDAR OVERSTORY. THICK DUFF. WESTERN HEMLOCK/CLINTONIA UNIFLORA/CLINTONIA UNIFLORA HABITAT TYPE. ASSOCIATED SPECIES: LINNAEA BOREALIS, PYROLA CHLORANTHA, TRILLIUM OVATUM, LISTERA SP., MENZIESIA FERRUGINEA, CAREX GEYERI, PAXISTIMA MYRSINITES, BERBERIS REPENS, AMELANCHIER ALNIFOLIA, SMILACINA RACEMOSA, LUPINE SP., SPIRAEA BETULIFOLIA, MELAMPYRUM LINEARE. COMPLETE LIST ON FILE AT MTHP.

Land owner/manager:

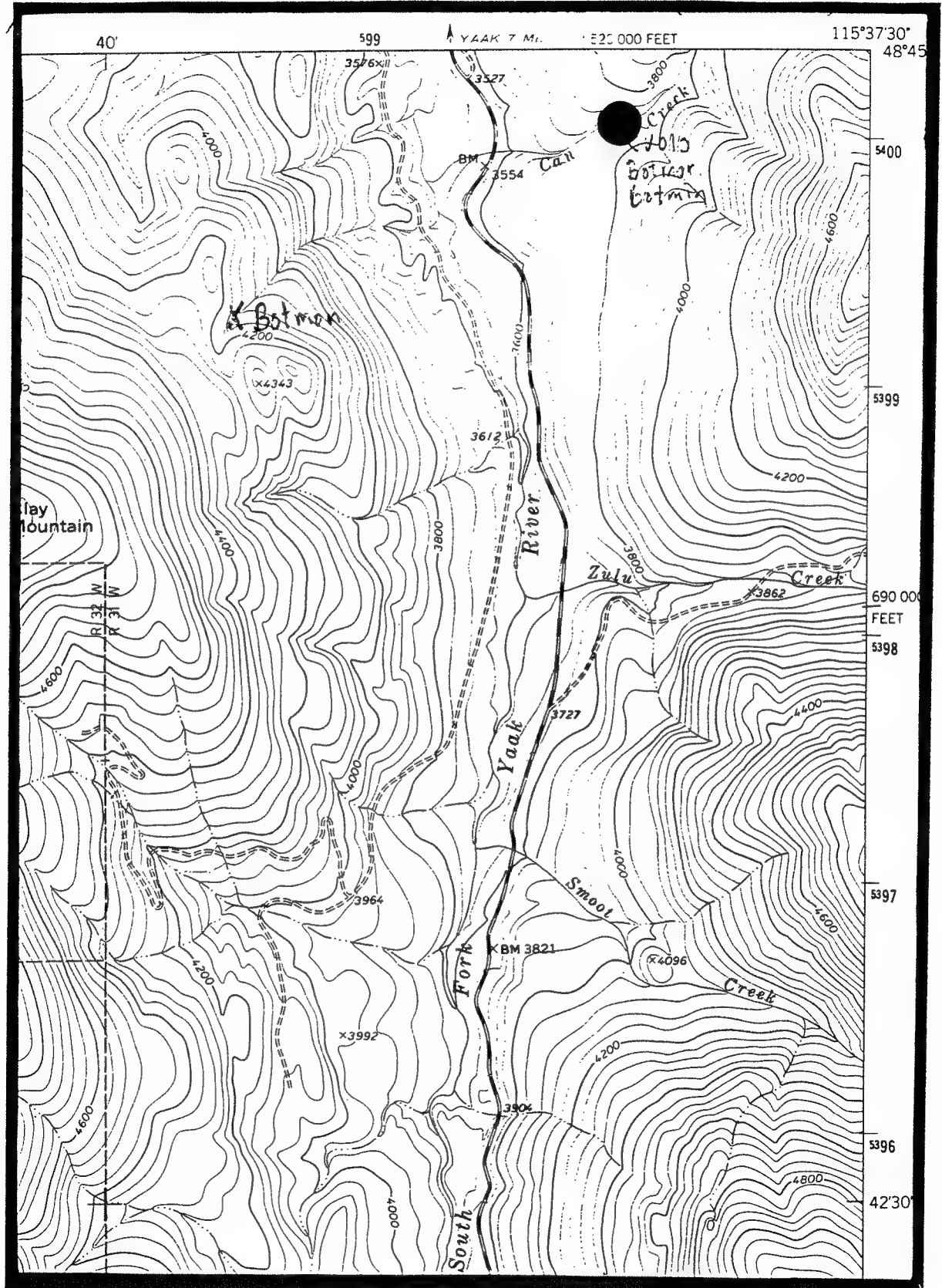
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:

VERIFICATION FROM W. H. WAGNER IS PENDING. OBSERVED BY LESLIE FERGUSON. SITE REVISITED IN 1995 BY J. VANDERHORST, L. FERGUSON, AND M. ARVIDSON. ONLY B. MONTANUM AND B. MINGANENSE FOUND. PHOTOCOPY OF SPECIMEN VERIFIED BY P. ZIKA.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY, MT 59935.

Specimens: VANDERHORST, J. (5510). 1995. MONTU.



*Botrychium montanum*; Can Creek (011)  
USGS Flatiron Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010K0.012  
Element occurrence type:

Survey site name: KELSEY CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: YAAK

Township: Range: Section: TRS comments:  
035N 031W 29 SW4 (UNSURVEYED SECTION)

Precision: S  
Survey date: Elevation: 3860 - 4000  
First observation: 1992 Slope/aspect: 0-5% / WEST  
Last observation: 1995-08-18 Size (acres): 5

Location:  
KELSEY CREEK. CA. 6 AIR MILES SOUTHEAST OF YAAK. FOLLOW COUNTY ROUTE  
68 FROM YAAK SOUTH CA. 7 MILES TO FS RD 6065. GO UP 6065 CA. 1.5 MILES  
TO CROSSING WITH KELSEY CREEK TRIBUTARY. POPULATION IS ABOVE ROAD ON  
BOTH SIDES OF THICKET OPENING.

Element occurrence data:  
100-200 PLANTS, 2 SUBPOPULATIONS, 100% WITH NEARLY MATURE SPOROPHORES.

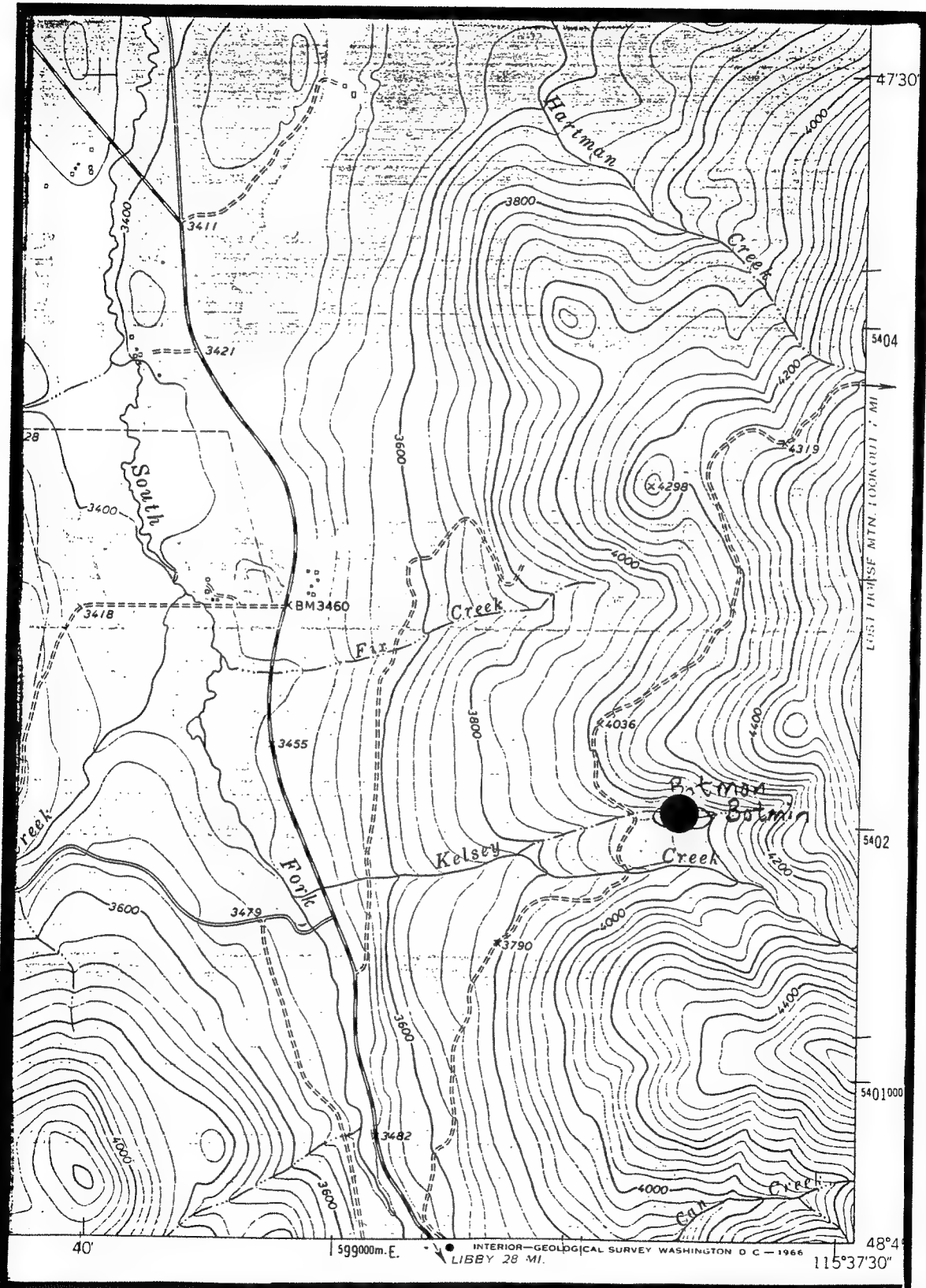
General site description:  
MOIST, SHADED, GLACIATED MOUNTAIN SLOPE DRAW BOTTOM. LANDTYPE 352.  
GLACIAL TILL AND ALLUVIAL PARENT MATERIAL, ORGANIC SOIL. ASSOCIATED  
SPECIES: THUJA PLICATA, LINNAEA BOREALIS, TIARELLA TRIFOLIATA, ABIES  
LASIOCARPA, CLINTONIA UNIFLORA, GALIUM TRIFLORUM, TRILLIUM OVATA,  
MITELLA NUDA, GOODYERA OBLONGIFOLIA, DISPORUM HOOKERI, OSMORHIZA  
CHILENSIS, MONESES UNIFLORA, BOTRYCHIUM MINGANENSE.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
SURVEYED BY J. VANDERHORST AND M. ARVIDSON. SPECIMEN PHOTOCOPY  
VERIFIED BY P. ZIKA. DESIGNATED BOTANICAL SPECIAL INTEREST AREA.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5539). 1995. MONTU.



Botrychium montanum; Kelsey Creek (012)  
USGS Yaak 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010K0.013  
Element occurrence type:

Survey site name: WEST PIPE CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: GOLD HILL

Township: Range: Section: TRS comments:  
032N 031W 8 E2; 9 NW4

Precision: S  
Survey date: Elevation: 3900 - 4240  
First observation: 1995-08-23 Slope/aspect: LEVEL, 1-5%/EAST  
Last observation: 1996-08-20 Size (acres): 10

Location:  
PURCELL MOUNTAINS, ON TRIBUTARY OF PIPE CREEK. CA. 11 AIR MILES NORTH  
OF LIBBY. ACCESS VIA PIPE CREEK ROAD (COUNTY RT. 68).

Element occurrence data:  
JULY, 1996: ADDITIONAL SUBPOPULATION FOUND IN SECTION 9; 6 PLANTS  
TOTAL, JUST EMERGING. AUGUST, 1996: 5 PLANTS WITH IMMATURE SPORES AT  
EASTERNMOST SUBPOPULATION. 1995: 50-100 PLANTS, 2 SUBPOPULATIONS, 100%  
WITH MATURING SPOROPHORES.

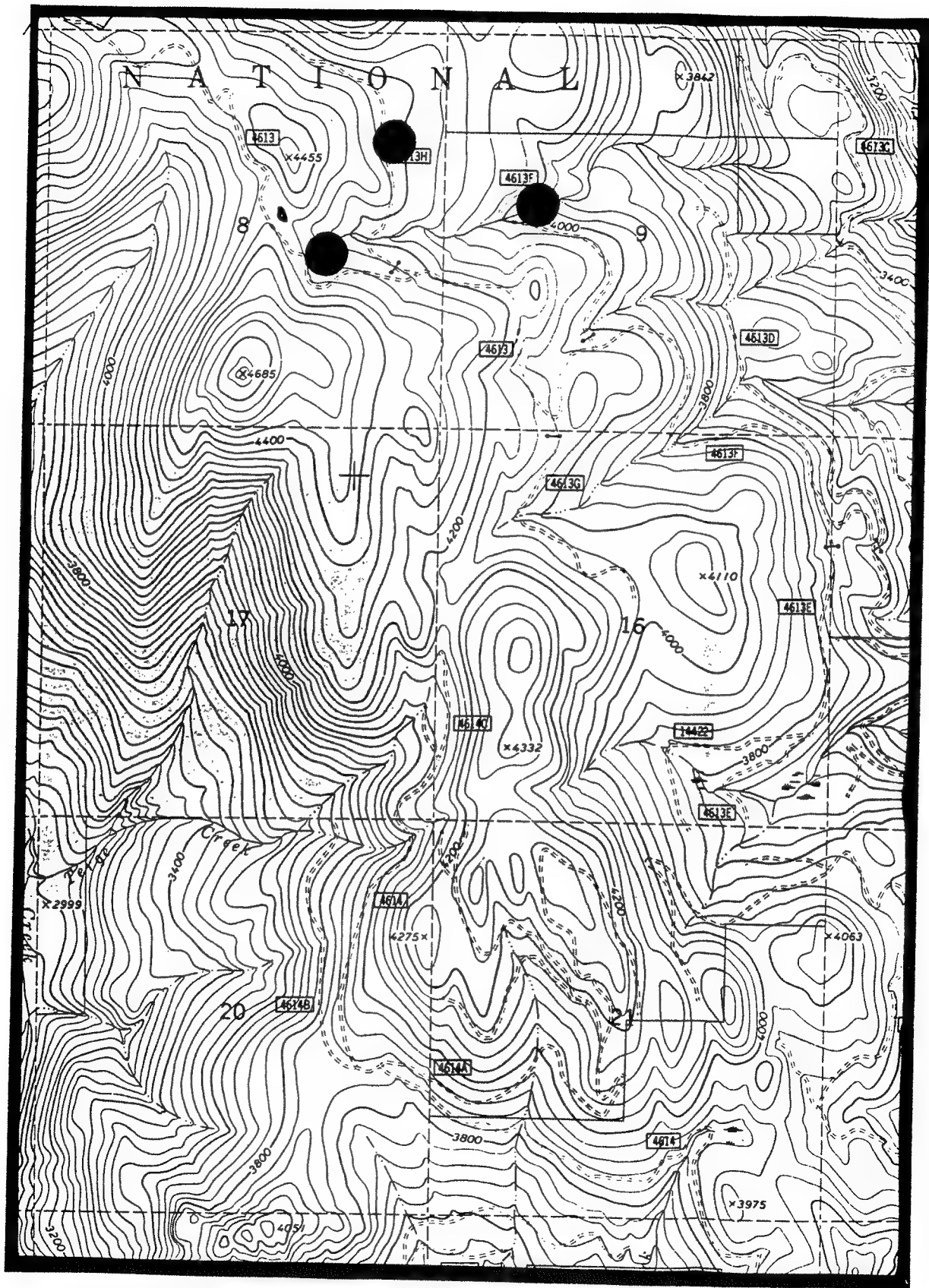
General site description:  
MOIST, PARTIAL TO HEAVY SHADE, GLACIATED MOUNTAIN STREAM VALLEY. UNDER  
CEDAR CANOPY AND IN UNUSUAL WETLAND THICKET HABITAT. LANDTYPE 329.  
ASSOCIATED SPECIES: THUJA PLICATA, CLINTONIA UNIFLORA, ALNUS SINUATA,  
OPLOPANAX HORRIDUM, PSEUDOTSUGA MENZIESII, VACCINIUM MEMBRANACEUM,  
ATHYRIUM FELIX-FEMINA, DISPORUM HOOKERI, LISTERA CAURINA, ADENOCaulon  
BICOLOR, ACER GLABRUM, BOTRYCHIUM VIRGINIANUM, ORTHILLÄ SECUNDA,  
SMILACINA STELLATA, BOTRYCHIUM MINGANENSE. ADDITIONAL SPECIES NOTED IN  
EASTERN SUBPOPULATION: GYMNOCARPIUM DRYOPTERIS, SENECIO TRIDENTATA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
OBSERVED BY J. RENY, T. BIELAK AND J. VANDERHORST. SPECIMEN PHOTOCOPY  
VERIFIED BY P. ZIKA. ECODATA PLOT FS01140596005.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5546). 1995. MONTU.



*Botrychium montanum*; West Pipe Creek (013)  
USGS Gold Hill 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010K0.014  
Element occurrence type:

Survey site name: CEDAR CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: SCENERY MOUNTAIN

Township: Range: Section: TRS comments:  
031N 032W 34 NW4

Precision: S  
Survey date: Elevation: 3480 - 3520  
First observation: 1995-08-04 Slope/aspect: LEVEL  
Last observation: 1995-08-04 Size (acres): 1

Location:  
CEDAR CREEK, CA. 5.5 AIR MILES WEST OF LIBBY. FROM HWY 2, DRIVE UP  
CEDAR CREEK ON FS RD 402 TO TRAIL HEAD. POPULATION IS UP CEDAR CREEK  
TRAIL, CA. 1 MILE ON LEVEL BENCH BETWEEN THE TRAIL AND CREEK.

Element occurrence data:  
15 PLANTS, 100% WITH IMMATURE SPOROPHORES.

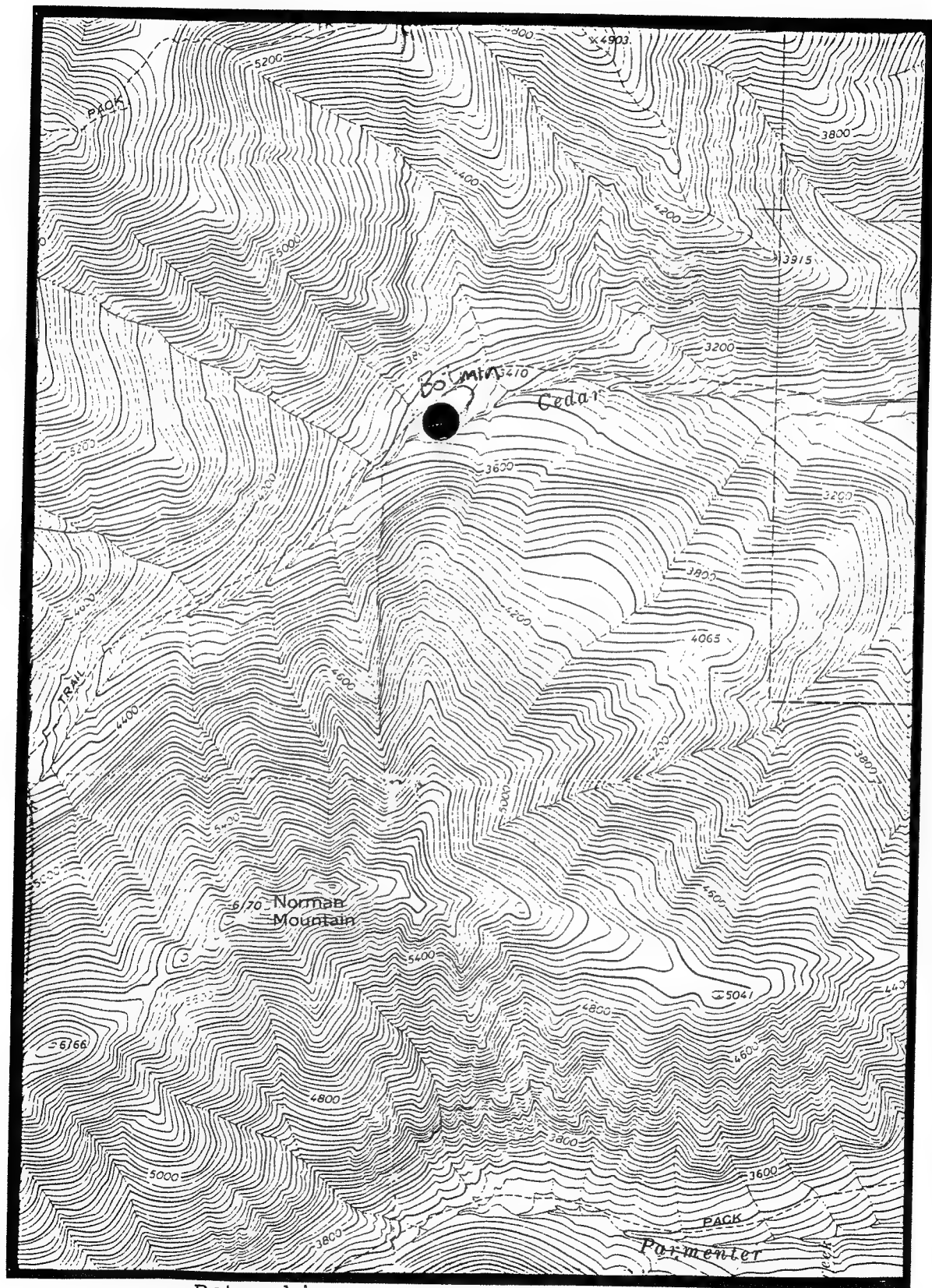
General site description:  
MOIST, SHADED SWALE BOTTOM ON GLACIATED VALLEY BENCH. LANDTYPE 407.  
GLACIAL TILL PARENT MATERIAL, ORGANIC HUMUS/DUFF SOIL. ASSOCIATED  
SPECIES: THUJA PLICATA, PSEUDOTSUGA MENZIESII, ABIES GRANDIS,  
CLINTONIA UNIFLORA, ADENOCaulon BICOLOR, SMILACINA STELLATA, TIARELLA  
TRIFOLIATA, GYMNOCARPIUM DRYOPTERIS, BOTRYCHIUM MINGANENSE, VIOLA SP.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
SURVEYED BY J. VANDERHORST. DISTURBANCE EVIDENCED BY OLD SAWED STUMP  
WITH FIRE SCAR. PHOTOCOPY OF SPECIMEN VERIFIED BY P. ZIKA.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5512)..1995. MONTU.



Botrychium montanum; Cedar Creek (014)  
USGS Scenery Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010K0.015  
Element occurrence type:

Survey site name: ZULU CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: PINK MOUNTAIN

Township: Range: Section: TRS comments:  
034N 031W 10 SW4

Precision: S  
Survey date: Elevation: 4640 -  
First observation: 1992 Slope/aspect: 0-5% / -  
Last observation: 1996-09-03 Size (acres): 10

Location:  
ZULU CREEK, CA. 9 AIR MILES SOUTHWEST OF YAAK. FROM FS RD 68, DRIVE UP  
FS RD 6079 CA. 3 MILES, TURN RIGHT ON SPUR ROAD, AND FOLLOW CA. 2  
MILES TO THIRD TRIBUTARY CROSSING. PLANTS ARE IN CREEK BOTTOM ABOVE  
ROAD AND CLEARCUTS.

Element occurrence data:  
1996: CA. 5 BOTRYCHIUM MONTANUM PLANTS IN GENUS COMMUNITY. 1 SEPTEMBER  
1995: 100% WITH MATURE DISPERSING SPORES. 9 AUGUST 1995: 100% IMMATURE  
SPOROPHORES.

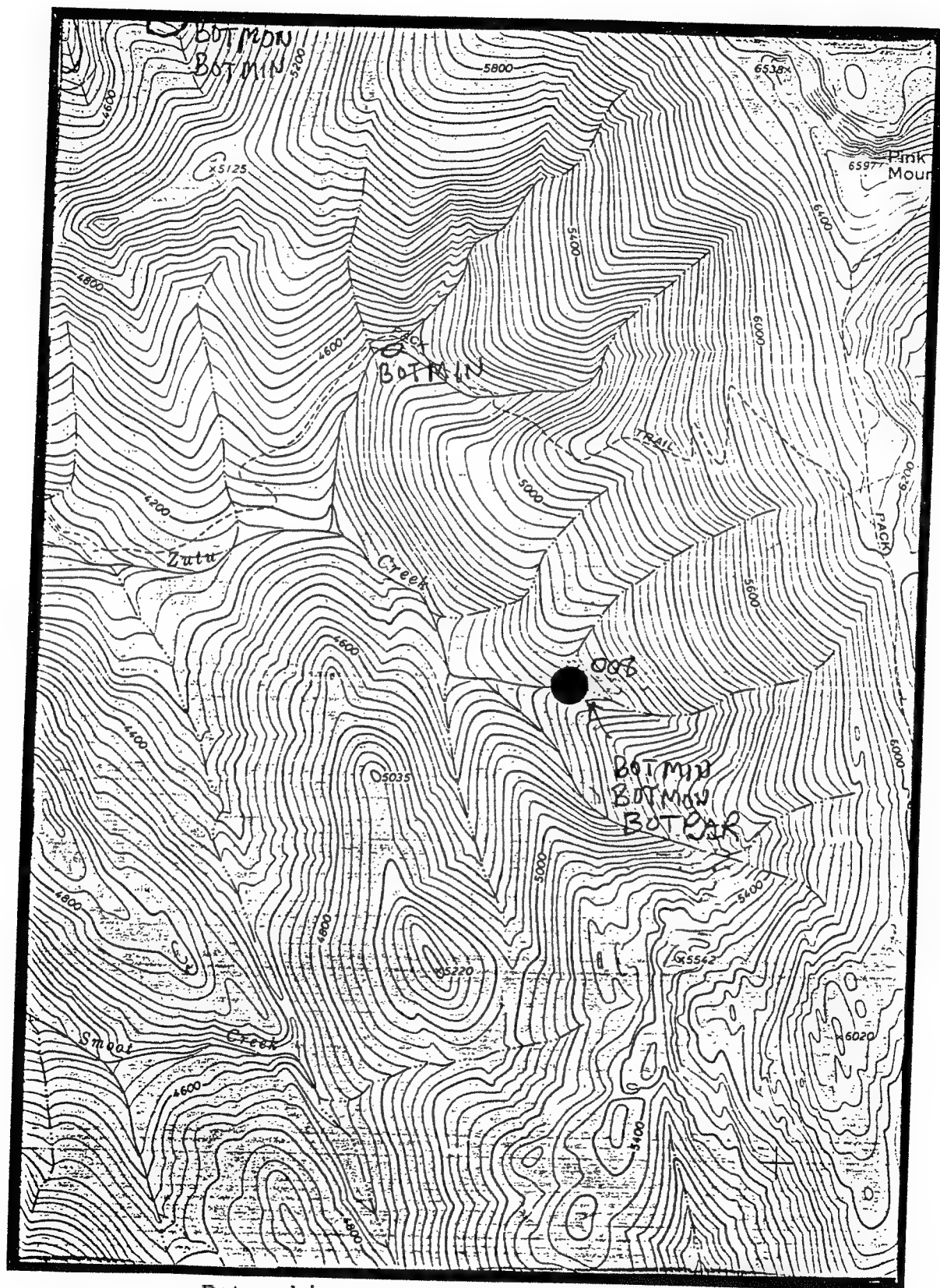
General site description:  
MOIST TO SATURATED, MOSSY, SHADED, GLACIATED VALLEY BOTTOM. LANDTYPE  
357. ALLUVIUM PARENT MATERIAL, ORGANIC DUFF SOIL. THUJA  
PLICATA/CLINTONIA UNIFLORA HABITAT TYPE. ASSOCIATED SPECIES: TIARELLA  
TRIFOLIATA, PICEA ENGELMANII, VERONICA AMERICANA, HABENARIA SACCATA,  
ACTAEA RUBRA, PSEUDOTSUGA MENZIESII, LARIX OCCIDENTALIS, ORTHILLA  
SECUNDA, MONESUS UNIFLORA, BOTRYCHIUM PARADOXUM, BOTRYCHIUM  
MINGANENSE, BOTRYCHIUM VIRGINIANUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST, M. ARVIDSON, AND L. SEDLER. DISTURBANCE BY  
LARGE WINDFALL, LEAVING POOLS OF SURFACE WATER. SITE WAS SAMPLED FOR  
PLANT COMPOSITION USING REPLICATED MICROPLOTS. ECODATA PLOT  
#FS01140395JV008.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5522). 1995. MONTU.



Botrychium montanum; Zulu Creek (015)  
USGS Pink Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3      Forest Service status: SENSITIVE  
State rank: S2      Federal Status:

Element occurrence code: PPOPH010K0.016  
Element occurrence type:

Survey site name: PIPE CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: GOLD HILL

Township: Range: Section: TRS comments:  
033N      031W      34      NW4

Precision: S  
Survey date:      Elevation: 3100 -  
First observation: 1995-08-23      Slope/aspect: LEVEL  
Last observation: 1995-08-23      Size (acres): 1

Location:  
PIPE CREEK. CA. 13 AIR MILES NORTH OF LIBBY. FROM LIBBY, DRIVE CA. 15  
MILES NORTH ON PIPE CREEK ROAD (COUNTY RT. 68). POPULATION IS EAST OF  
ROAD IN SMALL DRAW BEHIND GRAVEL PIT.

Element occurrence data:  
<20 PLANTS, 100% WITH MATURE SPOROPHORES.

General site description:  
MOIST, PARTIALLY SHADED GLACIATED MOUNTAIN VALLEY BOTTOM. LANDTYPE  
355. GLACIAL TILL, ALLUVIUM PARENT MATERIAL, ORGANIC SOIL. ASSOCIATED  
SPECIES: THUJA PLICATA, ALNUS SINUATA, RHAMNUS ALNIFLOIA, PICEA  
ENGELMANNII, ROSA WOODSII, SPIRAEA BETULIFOLIA, LONICERA INVOLUCRATA,  
SYMPHORICARPOS ALBUS, LINNNAEA BOREALIS, MITELLA NUDA, SMILACINA  
STELLATA, ARALIA NUDICAULIS, RUBUS IDAEUS.

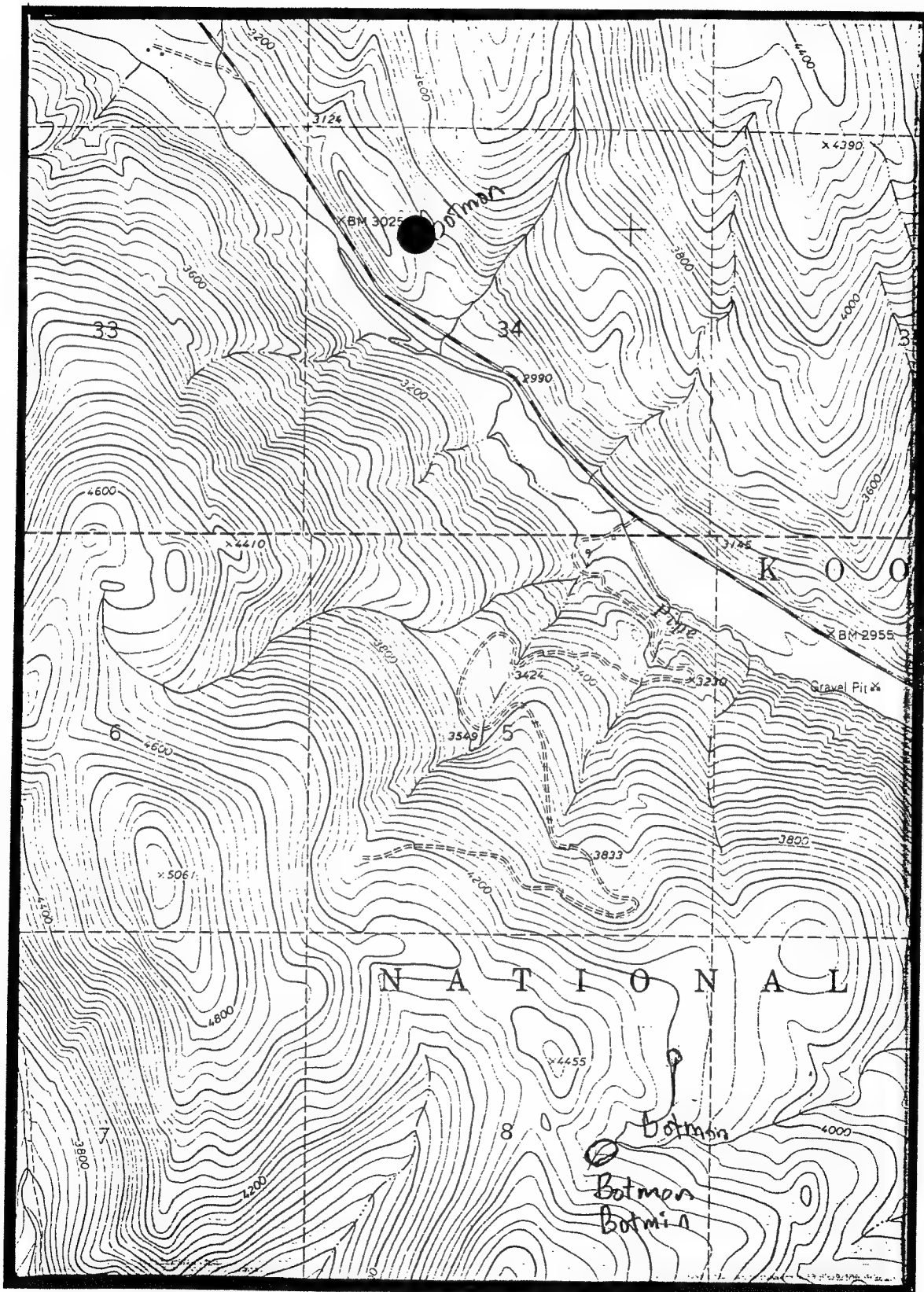
Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
OBSERVED BY T. BIELAK, J. RENY, AND J. VANDERHORST. PLANTS GROWING IN  
SWALE OF OLD, STABILIZED SKID TRAIL AND IN THICKET OPENING OFF OF SKID  
TRAIL.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5548). 1995. MONTU.





Botrychium montanum; Pipe Creek (016)  
 USGS Gold Hill 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3      Forest Service status: SENSITIVE  
State rank: S2      Federal Status:

Element occurrence code: PPOPH010K0.017  
Element occurrence type:

Survey site name: BERRAY MOUNTAIN CEDARS BOTANICAL AREA  
EO rank:  
EO rank comments:

County: SANDERS

USGS quadrangle: IBEX PEAK

Township: Range: Section: TRS comments:  
028N      033W      25      SW4 (UNSURVEYED SECTION)

Precision: S  
Survey date:      Elevation: 3800 -  
First observation: 1995-08-21      Slope/aspect: 0% / EAST  
Last observation: 1995-08-21      Size (acres): 5

Location:  
CABINET MOUNTAINS, BERRAY CEDARS. CA. 20 AIR MILES SOUTHWEST OF LIBBY.  
TAKE HIGHWAY 56 VIA SOUTH FORK BULL RIVER ROAD (FS RD 410) TO FS RD  
2272. FOLLOW FS RD 2272 CA. 2 MILES TO DRAW WITH HUGE CEDARS.  
POPULATION BELOW ROAD.

Element occurrence data:  
7 PLANTS, LOW VIGOR, MINUTE, DISFIGURED. CHLOROTIC, WIDELY SCATTERED  
IN HEAVY SHADE OF DEVILS CLUB. 100% WITH IMMATURE SPOROPHORES.

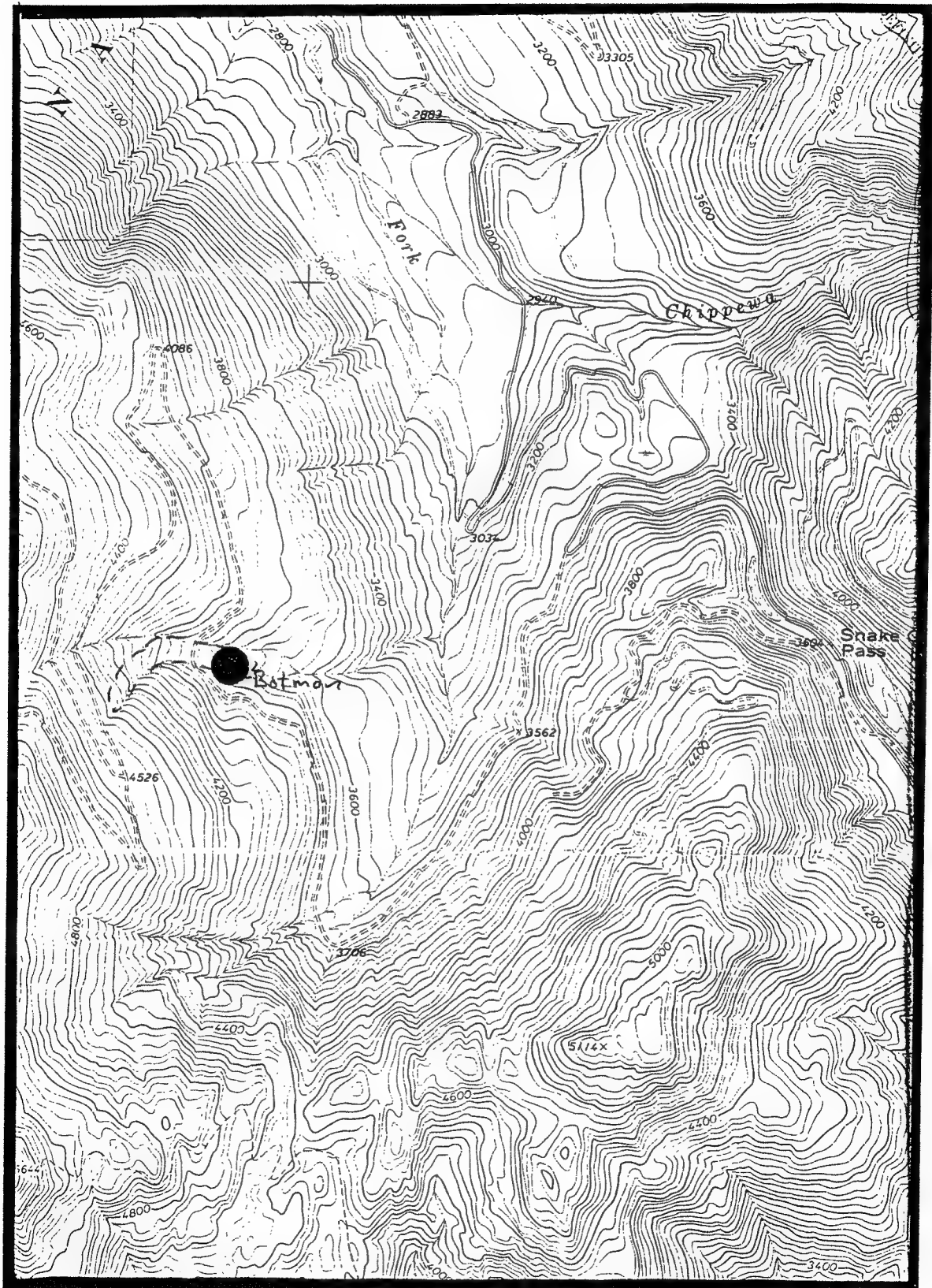
General site description:  
MOIST, HEAVILY SHADED, GLACIATED MOUNTAIN DRAW BOTTOM ON SLOPE.  
LANDTYPE 351. GLACIAL TILL PARENT MATERIAL, ORGANIC SOIL. ASSOCIATED  
SPECIES: THUJA PLICATA, OPLOPANAX HORRIDUM, GYMNOCARPIUM DRYOPTERIS,  
ASARUM CAUDATUM, COPTIS OCCIDENTALIS, TIARELLA TRIFOLIATA, DISPORUM  
HOOKERI, ATHYRIUM FELIX-FEMINA.

Land owner/manager:  
BERRAY MOUNTAIN CEDARS BOTANICAL AREA  
KOOTENAI NATIONAL FOREST, CABINET RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



Botrychium montanum; Berray Mountain Cedars (017)  
USGS Ibex Peak 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010K0.018  
Element occurrence type:

Survey site name: RODERICK BUTTE  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: YAAK

Township: Range: Section: TRS comments:  
035N 032W 26 NW4 (UNSURVEYED SECTION)

Precision: S  
Survey date: Elevation: 4360 -  
First observation: 1992 Slope/aspect: 0-5% / NE  
Last observation: 1995-08-18 Size (acres): 2

Location:  
PURCELL MOUNTAINS, RODERICK BUTTE. FROM YAAK, TRAVEL SOUTH ON COUNTY  
ROUTE 68 CA. 6 MILES TO FS RD 472. FOLLOW 472 CA. 4 MILES. POPULATION  
IS BETWEEN FS RD 472 AND FS RD 472F IN SLIGHT DRAW.

Element occurrence data:  
50-100 PLANTS, 100% WITH IMMATURE SPOROPHORES.

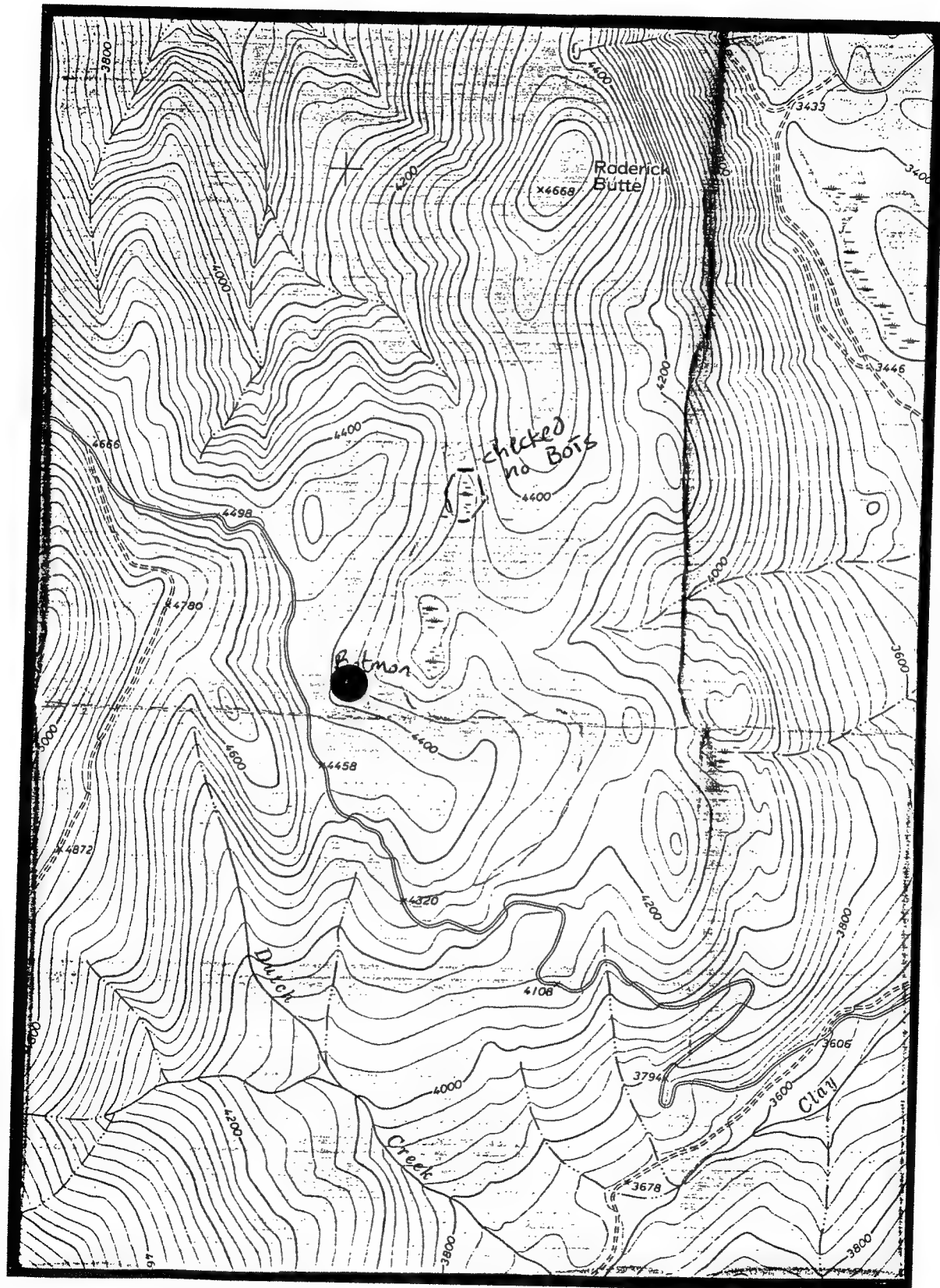
General site description:  
MOIST, PARTIALLY SHADED DRAW ON GLACIATED MOUNTAIN MIDSLOPE. LANDTYPE  
352. GLACIAL TILL PARENT MATERIAL, ORGANIC SOIL. ASSOCIATED SPECIES:  
THUJA PLICATA, PINUS ALBICAULIS, LINNAEA BOREALIS, CLINTONIA UNIFLORA,  
TIARELLA TRIFOLIATA, PICEA ENGELMANNII, MONESUS UNIFLORA, HIERACIUM  
ALBIFLORUM, VIOLA ORBICULATA, TAXUS BREVIFOLIA, RHYTIDIOPSIS ROBUSTA,  
BOTRYCHIUM VIRGINIANUM, OSMORHIZA CHILENSIS, RANUNCULUS UNCINIATA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY M. ARVIDSON, AND J. VANDERHORST. SPECIMEN PHOTOCOPY  
VERIFIED BY P. ZIKA.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5537). 1995. MONTU.



Botrychium montanum; Roderick Butte (018)  
USGS Yaak 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3      Forest Service status: SENSITIVE  
State rank: S2      Federal Status:

Element occurrence code: PPOPH010K0.019  
Element occurrence type:

Survey site name: CLAY MOUNTAIN  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: FLATIRON MOUNTAIN

Township: Range: Section: TRS comments:  
034N      031W      6      NW4 (UNSURVEYED SECTION)

Precision: S  
Survey date:      Elevation: 4160 -  
First observation: 1995-08-18      Slope/aspect: 0-5% / NORTH  
Last observation: 1995-08-18      Size (acres): 1

Location:  
CLAY MOUNTAIN, CA. 6.5 AIR MILES SSE OF YAAK. FROM YAAK/PIPE CREEK  
ROAD (COUNTY ROUTE 68), TAKE FS RD 472 WEST CA. 0.5 MILE AND TURN  
SOUTH ON FS RD 6114. TAKE 6114 CA. 1 MILE TO GATED FS RD 6839. FOLLOW  
6839 CA 2 MILES. POPULATION IS BELOW ROAD AND ABOVE CLEARCUT.

Element occurrence data:  
CA. 15 PLANTS, 100% WITH IMMATURE SPOROPHORES.

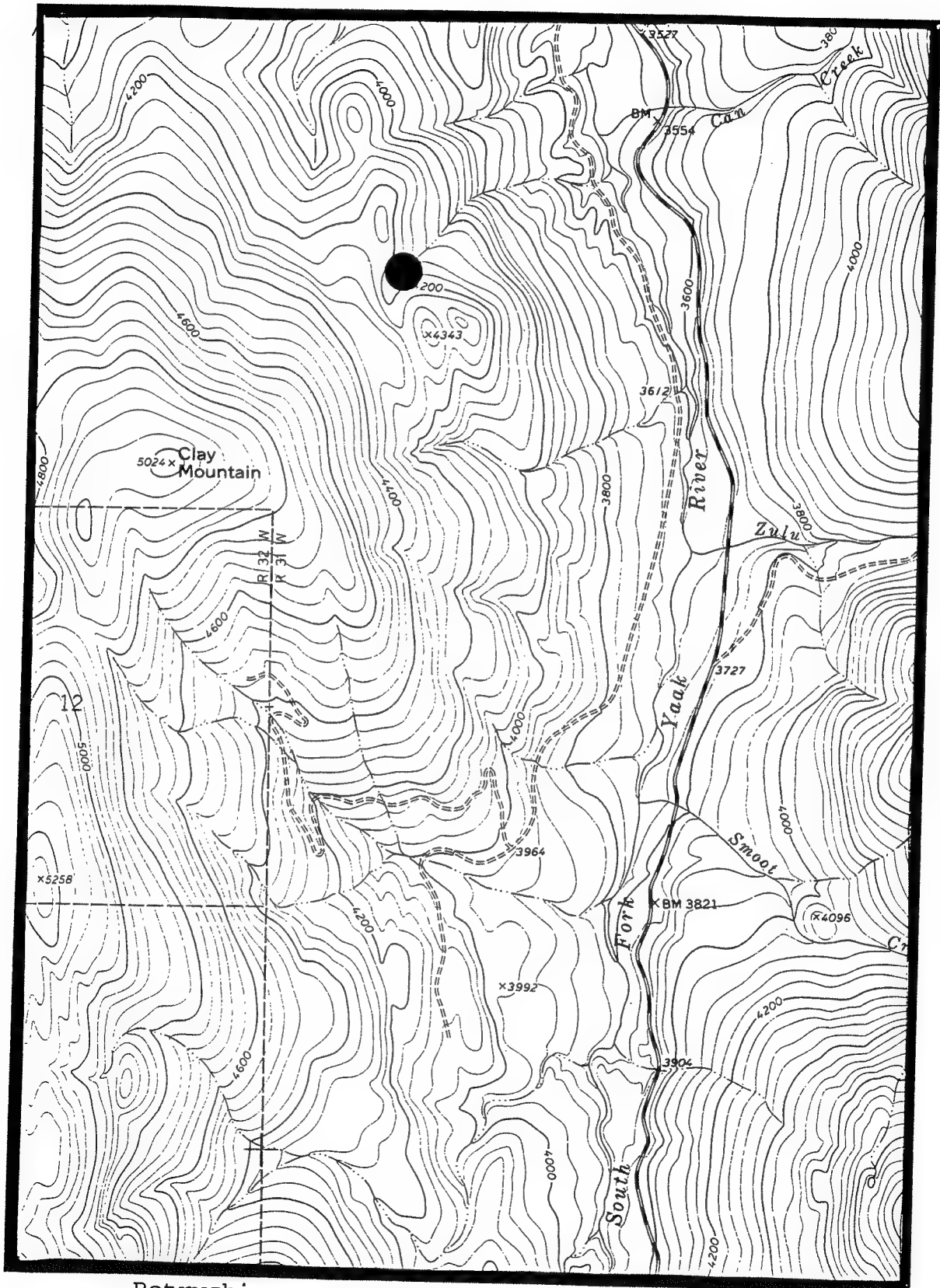
General site description:  
MOIST, SHADED BENCH ON GLACIATED MOUNTAIN MIDSLOPE. LANDTYPE 352.  
GLACIAL TILL PARENT MATERIAL, DUFF SOIL. ASSOCIATED SPECIES: THUJA  
PLICATA, PICEA ENGELMANNII, CLINTONIA UNIFLORA, TIARELLA TRIFOLIATA,  
TSUGA HETEROPHYLLA, RHYTIDIOPSIS ROBUSTA, PYROLA ASARIFOLIA,  
BOTRYCHIUM LANCEOLATUM, ACTAEA RUBRA, TRILLIUM OVATUM, VIOLA  
ORBICULATA, SMILACINA STELLATA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY M. ARVIDSON AND J. VANDERHORST. CLEARCUT BELOW POPULATION  
WITH NO MOONWORTS.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5535). 1995. MONTU.



Botrychium montanum; Clay Mountain (019)  
USGS Flatiron Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010K0.020  
Element occurrence type:

Survey site name: FRENCH CREEK  
EO rank: A  
EO rank comments: UNIT DROPPED FROM TIMBER SALE.

County: LINCOLN

USGS quadrangle: BONNET TOP  
GARVER MOUNTAIN

Township: Range: Section: TRS comments:  
037N 032W 34 SE4 (UNSURVEYED SECTION)

Precision: S  
Survey date: 1995-07-17 Elevation: 4040 - 4100  
First observation: 1993 Slope/aspect: - / NORTH, SOUTH  
Last observation: 1996-09-03 Size (acres): 1

Location:  
YAAK VALLEY, FRENCH CREEK. FROM YAAK, FOLLOW FS RD 92 NORTH CA. 9  
MILES TO FS RD 276. FOLLOW 276 CA. 2.5 MILES TO FS RD 5857 AND FOLLOW  
5857 INTO SECTION 34. SUBPOPULATIONS ARE BETWEEN THE ROAD AND FRENCH  
CREEK AND ACROSS CREEK.

Element occurrence data:  
1996: FEWER PLANTS THAN IN 1995. 1995: CA. 500 PLANTS IN 2  
SUBPOPULATIONS. 100% WITH IMMATURE SPOROPHORES.

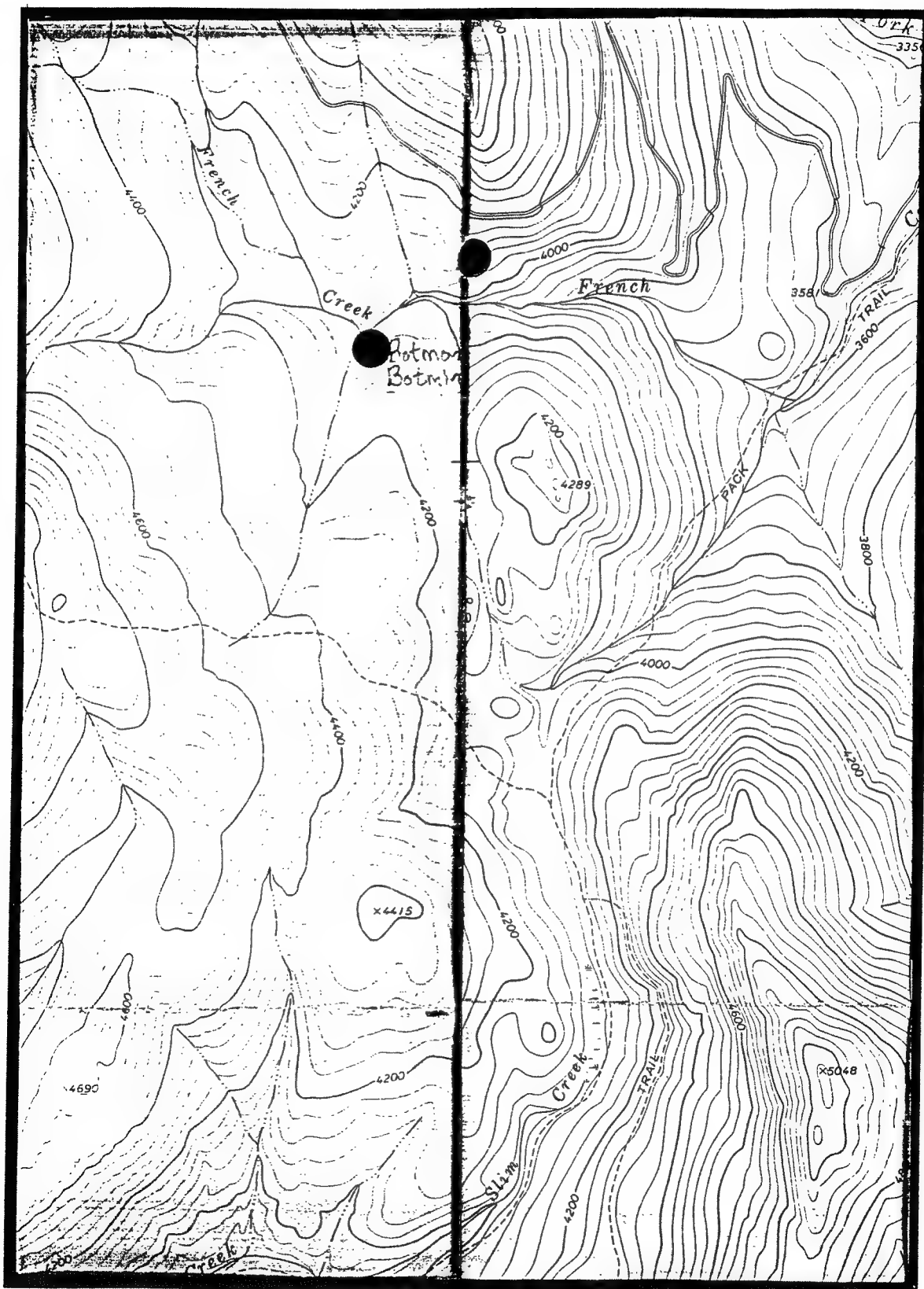
General site description:  
MOIST, OPEN, GLACIATED VALLEY MIDSLOPE BENCH SEEP. LANDTYPE 352.  
ORGANIC DUFF SOIL. ASSOCIATED SPECIES: THUJA PLICATA, ALNUS SINUATA,  
TSUGA HETEROPHYLLA, CLINTONIA UNIFLORA, BOTRYCHIUM MINGANENSE, B.  
VIRGINIANUM, LINNAEA BOREALIS, RANUNCULUS UNCINIATUS, ATHYRIUM  
FILIX-FEMINA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
PERMANENT MONITORING TRANSECTS ESTABLISHED IN 1995. OBSERVED BY L.  
FERGUSON, M. ARVIDSON, AND J. VANDERHORST IN 1995, J. VANDERHORST IN  
1996 (ECODATA PLOT FS01140296JV003). PHOTOCOPY OF SPECIMEN VERIFIED BY  
P. ZIKA.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5449). 1995. MONTU.



Botrychium montanum; French Creek (020)  
USGS Bonnet Top and Garver Mountain 7.5' quadrangles



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3      Forest Service status: SENSITIVE  
State rank: S2      Federal Status:

Element occurrence code: PPOPH010K0.021  
Element occurrence type:

Survey site name: EVERETT CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: URAL

Township: Range: Section: TRS comments:  
032N      , 029W      3      NE4

Precision: S  
Survey date:      Elevation: 3760 -  
First observation: 1995-09-06      Slope/aspect:  
Last observation: 1995-09-06      Size (acres):

Location:  
TAKE LAWRENCE MOUNTAIN ROAD (FS RD 4851) TO FS RD 863. GO UP FS RD 863  
CA. 5-5.5 MILES. PARK AT SHARP SWITCHBACK TO RIGHT. WALK UP FS RD 863  
CA. 100 YARDS TO CULVERT CROSSING. WALK UP STREAM 0.25-0.5 MILE UNTIL  
GROUND BECOMES VERY FLAT WITH CEDAR OVERSTORY. SITE IS SMALL GREEN  
PATCH ALONG STREAM.

Element occurrence data:

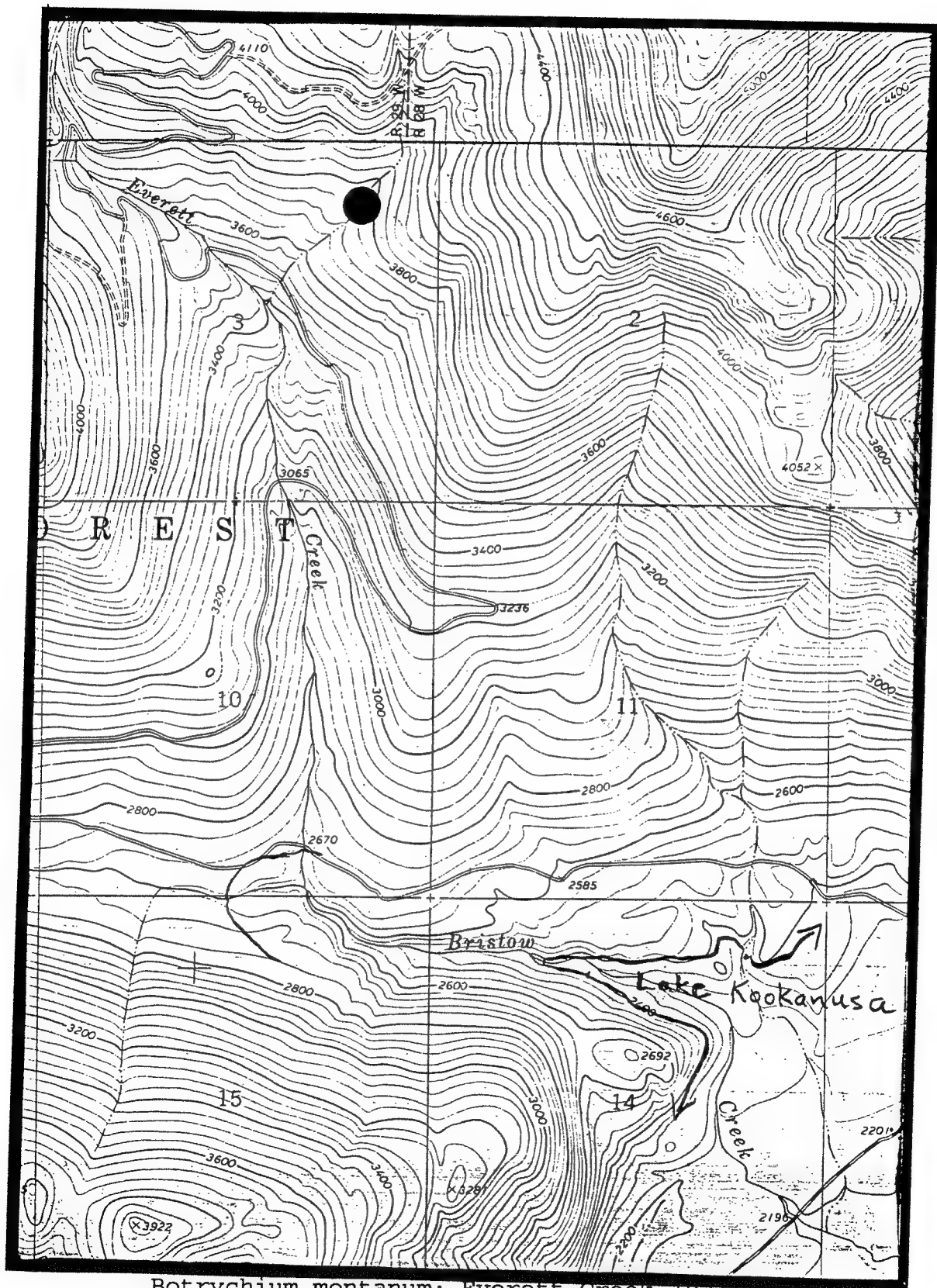
General site description:  
LANDTYPE 352. ASSOCIATED SPECIES: THUJA PLICATA, ROSA GYMNOCARPA,  
SYMPHORICARPOS ALBUS, RUBUS PARVIFLORUS, ALNUS SINUATA, RIBES  
LACUSTRE, VIOLA GLABELLA, SMILACINA STELLATA, GALIUM TRIFIDUM,  
ACONITUM COLUMBIANUM, CIRCAEA ALPINA, ADENOCaulon BICOLOR, ARNICA  
CORDIFOLIA, BOTRYCHIUM VIRGINIANUM, GLYCERIA SP., ARALIA NUDICAULIS.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, LIBBY RANGER DISTRICT

Comments:  
OBSERVED BY T. BIELAK AND J. RENY. SPECIMEN PHOTOCOPY VERIFIED BY P.  
ZIKA.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens: BIELAK, T. (6). 1995. KNF HERBARIUM, LIBBY.



Botrychium montanum; Everett Creek (021)  
USGS Ural 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010K0.022  
Element occurrence type:

Survey site name: RED TOP CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: NEWTON MOUNTAIN

Township: Range: Section: TRS comments:  
034N 034W 2 SW4 (UNSURVEYED SECTION)

Precision: S  
Survey date: Elevation: 4600 -  
First observation: 1995-07-19 Slope/aspect: 10-40% / SOUTH  
Last observation: 1995-07-19 Size (acres): 20

Location:  
PURCELL MOUNTAINS. FROM YAAK RIVER ROAD (HWY 508) FOLLOW FS RD 393 CA.  
10 MILES TO CROSSING OF RED TOP CREEK. POPULATION IS UPSTREAM ON  
SOUTHWEST FACING SLOPES ABOVE CREEK, ON BENCH UPSTREAM FROM CLEARCUT.

Element occurrence data:  
50 PLANTS WITH NEARLY MATURE SPORANGIA.

General site description:  
MOIST, SHADED, GLACIATED MOUNTAIN MIDSLOPE. LANDTYPE 352. GLACIAL TILL  
PARENT MATERIAL, ORGANIC SOIL. ASSOCIATED SPECIES: THUJA PLICATA,  
OPLOPANAX HORRIDUM, ATHYRIUM FILIX-FEMINA, GYMNOCARPIUM DRYOPTERIS,  
CLINTONIA UNIFLORA, TIARELLA TRIFOLIATA, SMILACINA STELLATA, GALIUM  
TRIFLORUM, ACER GLABRUM, BOTRYCHIUM PINNATUM, B. MINGANENSE, B.  
LANCEOLATUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST AND L. FERGUSON. PLANTS GROWING NEXT TO  
CLEARCUT AREA LOGGED 5 YEARS AGO. ROAD RUNOFF IS MOVING ROCKS INTO  
FOREST DUFF. MANY MOONWORTS FOUND ON EDGE OF RUNOFF CHANNELS. ECODATA  
PLOT FS01140395JV006.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3      Forest Service status: SENSITIVE  
State rank: S2      Federal Status:

Element occurrence code: PPOPH010K0.024  
Element occurrence type:

Survey site name: SUTTON CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: BEARTRAP MOUNTAIN

Township: Range: Section: TRS comments:  
035N      028W      33      NW4

Precision: S  
Survey date:      Elevation: 3120 -  
First observation: 1995-06-26      Slope/aspect: - / WEST  
Last observation: 1996-07-11      Size (acres): 1

Location:  
SUTTON CREEK, CA. 12 AIR MILES SOUTHWEST OF EUREKA. ACCESS VIA HWY 37  
FROM LAKE KOOCANUSA TO FS RD 619 UP SUTTON CREEK. SITE IS LOCATED  
SOUTH OF ROAD ALONG NORTH SIDE OF CREEK.

Element occurrence data:  
1996: 30 PLANTS. 1995: 2 PLANTS.

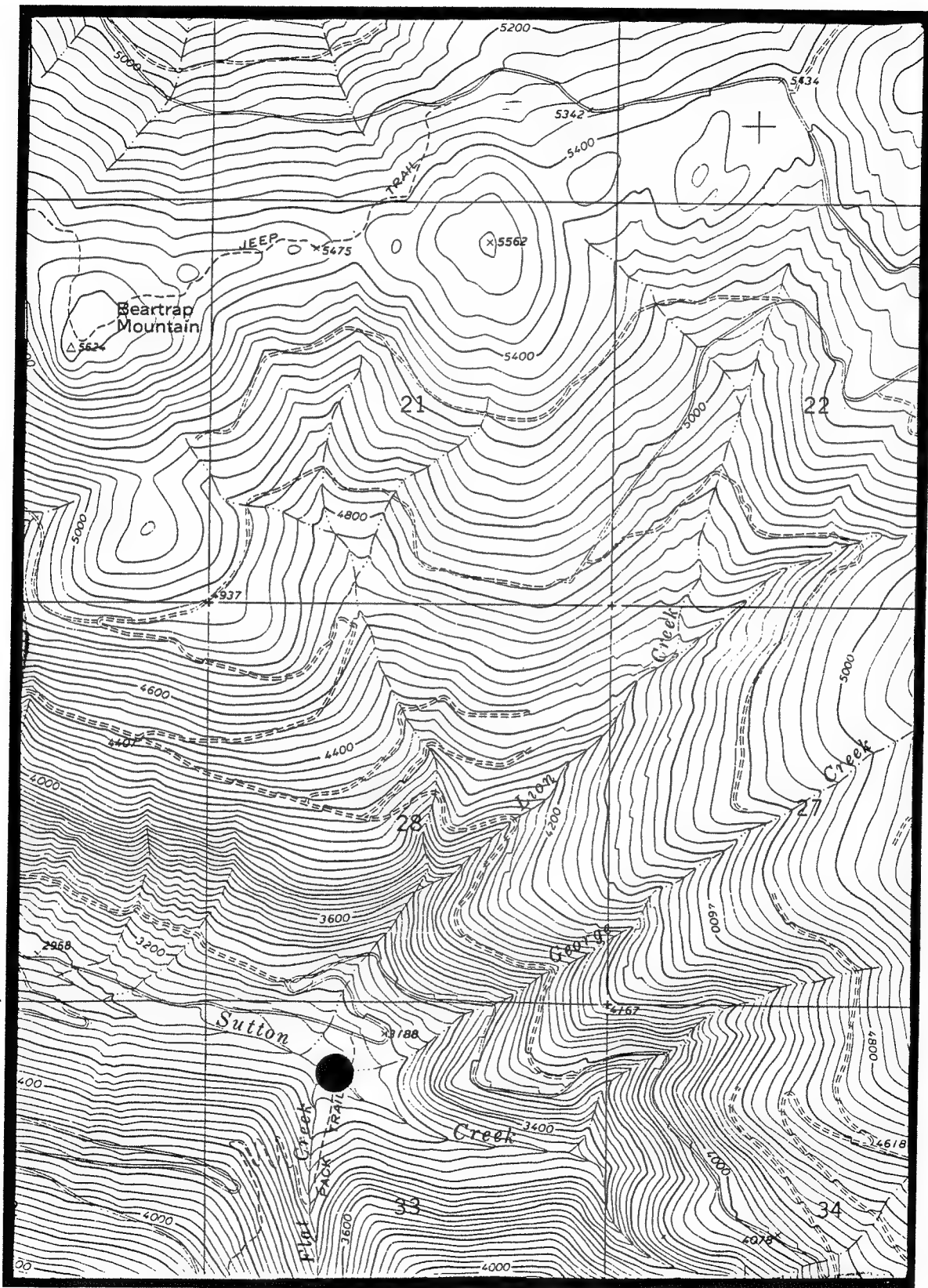
General site description:  
GLACIATED VALLEY BOTTOM, FLOODPLAIN HUMMOCKS AND CHANNELS, HEAVY DUFF  
OVER ROCKY ALLUVIUM. ASSOCIATED SPECIES: BOTRYCHIUM LANCEOLATUM, B.  
PINNATUM, B. LANCEOLATUM, THUJA PLICATA, OPLOPANAX HORRIDUM, GOODYERA  
OBLONGIFOLIA, CORNUS CANADENSIS, SMILACINA STELLATA, MITELLA NUDA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
OBSERVED IN 1996 BY J. VANDERHORST; IN 1995 BY T. SPRIBILLE, A.  
DUEKER, AND OTHERS. SURVEY FORM COMPILED BASED ON INFORMATION FROM J.  
TRIEPKE.

Information source: SPRIBILLE, TOBY. FORTINE RANGER DISTRICT. P.O. BOX  
116, FORTINE, MT 59918.

Specimens:



*Botrychium montanum*; Sutton Creek (024)  
USGS Beartrap Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3      Forest Service status: SENSITIVE  
State rank: S2      Federal Status:

Element occurrence code: PPOPH010K0.025  
Element occurrence type:

Survey site name: MOUNT BALDY  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: MOUNT BALDY

Township: Range: Section: TRS comments:  
036N      033W      33      32

Precision: S  
Survey date:      Elevation: 3960 - 4500  
First observation: 1993-09-20      Slope/aspect: - / NE  
Last observation: 1996-08-01      Size (acres): 40

Location:  
EAST SLOPE OF MOUNT BALDY ABOVE SPREAD CREEK, CA. 7 AIR MILES WEST OF  
YAAK. ACCESS VIA FS RD 5955 FROM YAAK RIVER ROAD (COUNTY RT. 508)

Element occurrence data:  
1996: 8 PLANTS SEEN, WIDELY SCATTERED. 4 SUBPOPULATIONS. 1993: 5  
PLANTS COLLECTED.

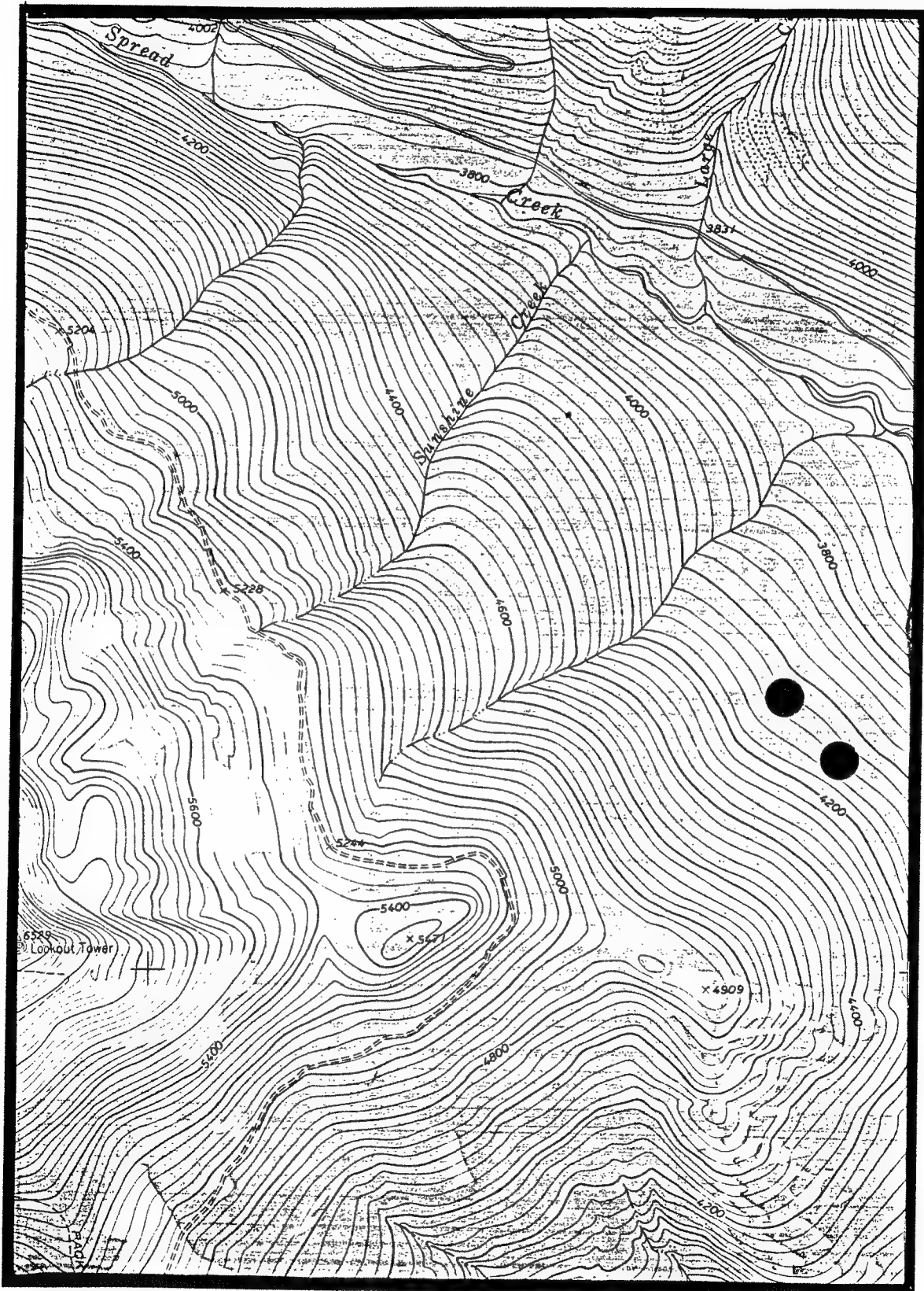
General site description:  
ASSOCIATED SPECIES: BOTRYCHIUM MINGANENSE, THUJA PLICATA, OPLOPANAX  
HORRIDUM, PICEA, ATHYRIUM FILIX-FEMINA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
1996: OBSERVED BY J. VANDERHORST; 1993: OBSERVED BY L. FERGUSON AND T.  
DESY.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens: FERGUSON, L. (S.N.). 1993. PERSONAL COLLECTION.



Botrychium montanum; Mount Baldy (025)  
USGS Mount Baldy 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3      Forest Service status: SENSITIVE  
State rank: S2      Federal Status:

Element occurrence code: PPOPH010K0.026  
Element occurrence type:

Survey site name: HOUGHTON CREEK  
EO rank: B  
EO rank comments: JUST ONE PLANT.

County: LINCOLN

USGS quadrangle: KENELTY MOUNTAIN

Township: Range: Section: TRS comments:  
026N      029W      24      NW4

Precision: S  
Survey date: 1996-07-30      Elevation: 3820 -  
First observation: 1996-07-30      Slope/aspect: 10% / WEST  
Last observation: 1996-07-30      Size (acres): 1

Location:  
HOUGHTON CREEK. FROM LIBBY, DRIVE SOUTH ON HWY 2 CA. 30 MILES TO FS RD  
6761. THEN, FOLLOW 6761 TO SWITCHBACK IN NORTHWEST CORNER OF SECTION  
24. SITE IS DOWNHILL AND ACROSS RAVINE ABOVE STREAM CONFLUENCE.

Element occurrence data:  
ONE PLANT SEEN WITH IMMATURE SPORANGIA.

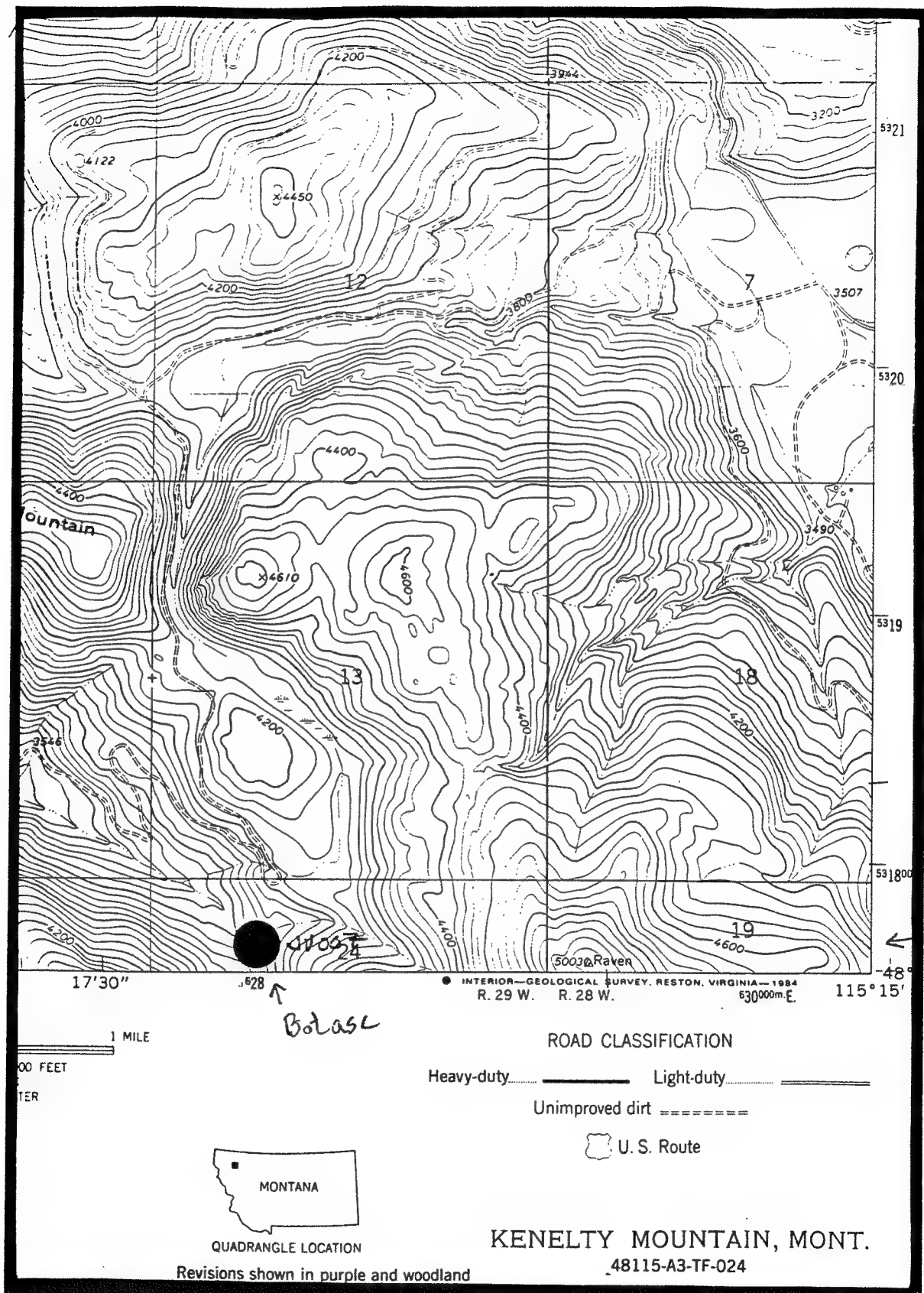
General site description:  
SHADY MOIST BOTTOM IN A WETLAND THICKET. DUFF OVER SILT SOIL, ALLUVIUM  
PARENT MATERIAL. ASSOCIATED SPECIES: ACER GLABRUM, ALNUS SINUATA,  
CORNUS STOLONIFERA, SYMPHORICARPOS ALBA, BOTRYCHIUM ASCENDENS, SENECIO  
TRIANGULARIS, CIRSIUM ARVENSE, PYROLA ASARIFOLIA, ATHYRIUM  
FILIX-FEMINA, EQUISETUM ARVENSE.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FISHER RIVER RANGER DISTRICT

Comments:  
OBSERVED BY JIM VANDERHORST, JON RENY, TERESE BIELAK, JOE ELLIOT.  
ECODATA PLOT #FS01140596JV007. COMPLETE SURVEY IMPOSSIBLE DUE TO HEAVY  
VEGETATION COVER. RIPARIAN THICKET HABITAT IS VERY UNUSUAL FOR B.  
MONTANUM.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



*Botrychium montanum*; Houghton Creek (026)  
USGS Kenelty Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3      Forest Service status: SENSITIVE  
State rank: S2      Federal Status:

Element occurrence code: PPOPH010K0.027  
Element occurrence type:

Survey site name: KEELER CREEK  
EO rank: C  
EO rank comments: ONLY 1 PLANT, SMALL AREA OF HABITAT,  
HEAVILY-IMPACTED DRAINAGE.

County: LINCOLN

USGS quadrangle: SPAR LAKE

Township: Range: Section: TRS comments:  
030N      034W      29      SE4NE4; 28 SW4NW4

Precision: S  
Survey date: 1996-09-19      Elevation: 2880 -  
First observation: 1996-09-19      Slope/aspect: LEVEL  
Last observation: 1996-09-19      Size (acres):

Location: .  
FROM TROY, GO SOUTH ON HWY 2 CA. 2 MILES, THEN TURN ONTO HWY 384 CA  
6.5 MILES. THEN GO WEST ON FS RD 473 TO MILE 6 MARKER (2 MILES WEST OF  
JUNCTION WITH FS RD 2201). GO SOUTH TO KEELER CREEK. OCCURRENCE IS IN  
CEDAR GROVE ON NORTH SIDE OF CREEK ACROSS FROM CLIFFS.

Element occurrence data:  
ONE PLANT WITH MATURE SPORANGIA.

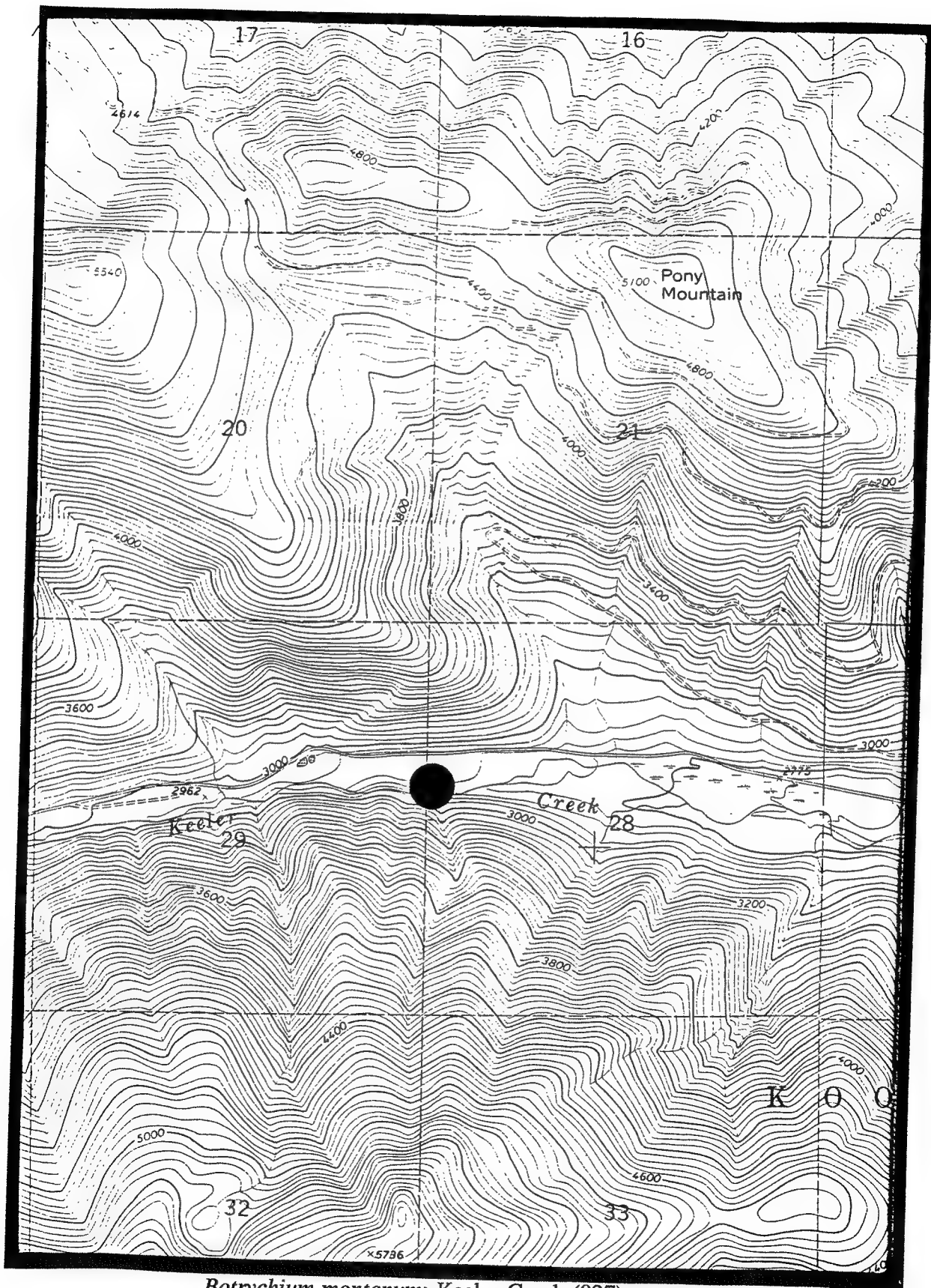
General site description:  
MOIST, SHADY FLOODPLAIN BOTTOM, DUFF SOIL AND PARENT. THUJA  
PLICATA/OPLOPANAX HORRIDUM HT, WITH TSUGA HETEROPHYLLA, TIARELLA  
TRIFOLIATA, ATHYRIUM FILIX-FEMINA, GYMNOCARPIUM DRYOPTERIS, SMILACINA  
STELLATA, BOTRYCHIUM LANCEOLATUM, BOTRYCHIUM PEDUNCULOSUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY JIM VANDERHORST AND LESLIE FERGUSON. CREEKBED AFFECTED BY  
LARGE-SCALE FLOOD EVENTS IN PAST; HEAVY LOGGING IN DRAINAGE.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



*Botrychium montanum*; Keeler Creek (027)  
USGS Spar Lake 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3      Forest Service status: SENSITIVE  
State rank: S2      Federal Status:

Element occurrence code: PPOPH010K0.028  
Element occurrence type:

Survey site name: STERLING CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: DAVIS MOUNTAIN

Township: Range: Section: TRS comments:  
033N      027W      16      W2

Precision: S  
Survey date:      Elevation: 4640 - 4880  
First observation: 1996-09-16      Slope/aspect: 17% / NE  
Last observation: 1996-09-16      Size (acres): 10

Location:  
FROM LIBBY, TAKE HWY 37 CA. 20 MILES, TURN ONTO FS RD 835 CA. 13  
MILES, THEN FS RD 36 CA. 9 MILES, WEST ON FS RD 48 CA. 4 MILES, THEN  
CA. 3 MILES ON FS RD 3562. SITE IS ABOVE FS RD 3562-B ON  
NORTHEAST-FACING SLOPE.

Element occurrence data:  
CA. 100 PLANTS WITH IMMATURE SPORANGIA SCATTERED OVER A WIDE AREA.

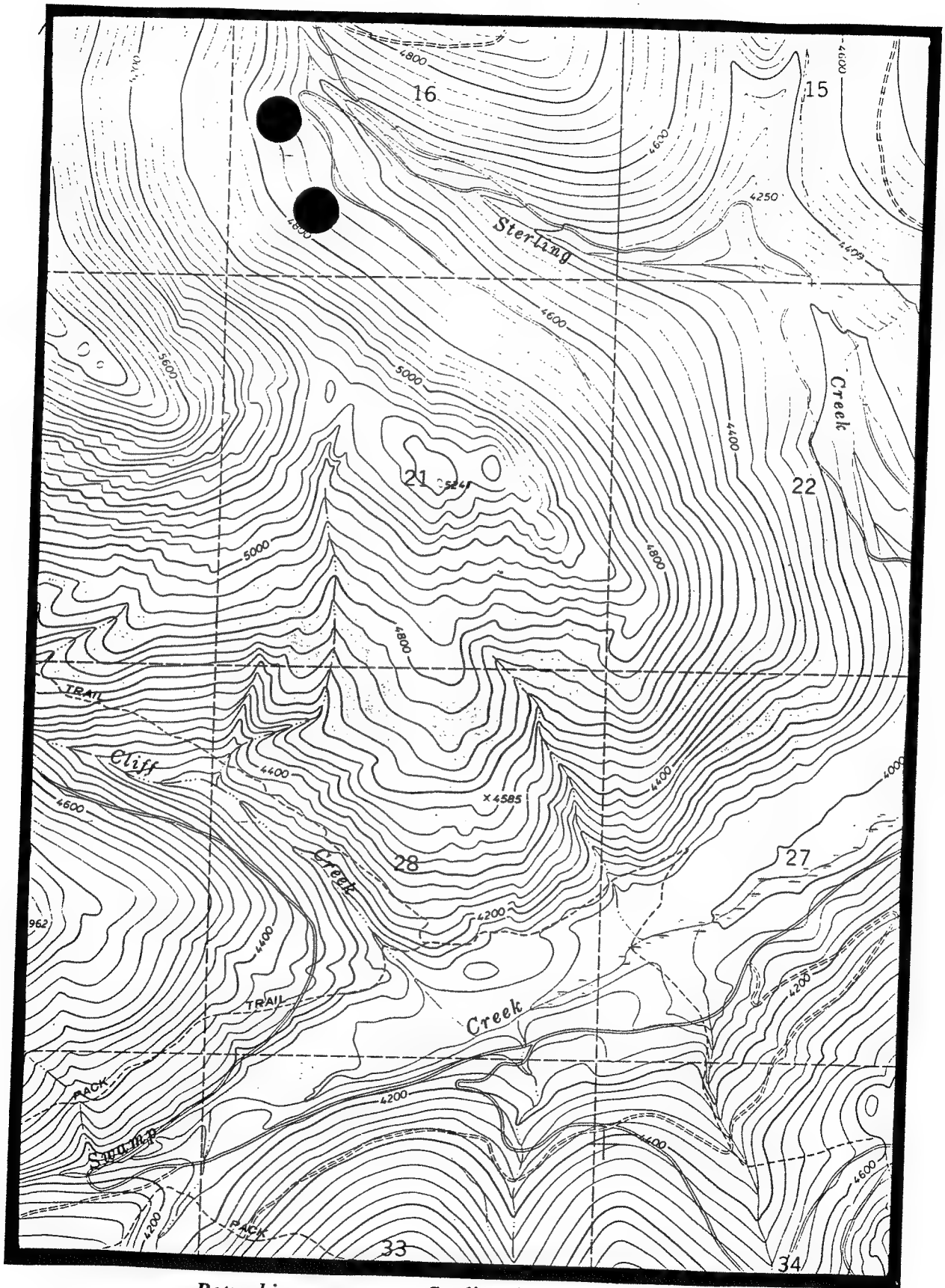
General site description:  
SHADED OLD-GROWTH FOREST. PLANTS NOTABLY CONCENTRATED ON THE OLDEST  
GROVES IN AREAS THAT RECEIVE VERNAL FLUSHING AND HAVE AN ABUNDANCE OF  
OPLOPANAX HORRIDUM IN THE UNDERSTORY. ASSOCIATED PLANT SPECIES:  
GYMNOCARPIUM DRYOPTERIS, ATHYRIUM FILIX-FEMINA, DRYOPTERIS  
CARTHUSIANA, ROELLIA ROELLII, BRACHYTHECIUM VELUTINUM AGGR. BOTRYCHIUM  
ASCENDENS ALSO PRESENT.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, FORTINE RANGER DISTRICT

Comments:  
OBSERVED BY T. SPRIBILLE. ECODATA PLOT #FS01140396TS313,  
FS01140396TS315. HEAVY UNGULATE USE IN AREA.

Information source: SPRIBILLE, TOBY. BOX 2106, COLUMBIA FALLS, MONTANA  
59912.

Specimens: SPRIBILLE, T. (S.N.). 1996. KOOTENAI NF, FORTINE  
DISTRICT HERBARIUM.



*Botrychium montanum*; Sterling Creek (028)  
USGS Davis Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3      Forest Service status: SENSITIVE  
State rank: S2      Federal Status:

Element occurrence code: PPOPH010K0.029  
Element occurrence type:

Survey site name: SOUTH FORK BIG CREEK  
EO rank: A  
EO rank comments: LARGE POPULATION.

County: LINCOLN

USGS quadrangle: PARSNIP MOUNTAIN

Township: Range: Section: TRS comments:  
034N      030W      4      NE4

Precision: S  
Survey date: 1996-07-24      Elevation: 3200 - 3240  
First observation: 1996-07-24      Slope/aspect: LEVEL  
Last observation: 1996-07-24      Size (acres): 10

Location:  
GO NORTH FROM LIBBY ON HWY 68 CA. 15 MILES, THEN EAST ONTO FS RD 336  
CA. 12 MILES. SITE IS ON THE SOUTH FORK OF BIG CREEK CA. 0.3 MILES  
DOWNSTREAM OF THE CONFLUENCE WITH COPELAND CREEK.

Element occurrence data:  
50+ PLANTS; 100% WITH IMMATURE SPORANGIA.

General site description:  
SHADY MOIST BOTTOM ON A FLOODPLAIN. B. MONTANUM CONFINED TO HUMMOCKS  
WITH HEAVY LITTER. THUJA PLICATA/OPLOPANAX HORRIDUM HT, WITH ABIES  
LASIOCARPA, TAXUS BREVIFOLIA, TIARELLA TRIFOLIATA, CLINTONIA UNIFLORA,  
BOTRYCHIUM VIRGINIANUM, BOTRYCHIUM MINGANENSE, BOTRYCHIUM LANCEOLATUM,  
BOTRYCHIUM PEDUNCULOSUM.

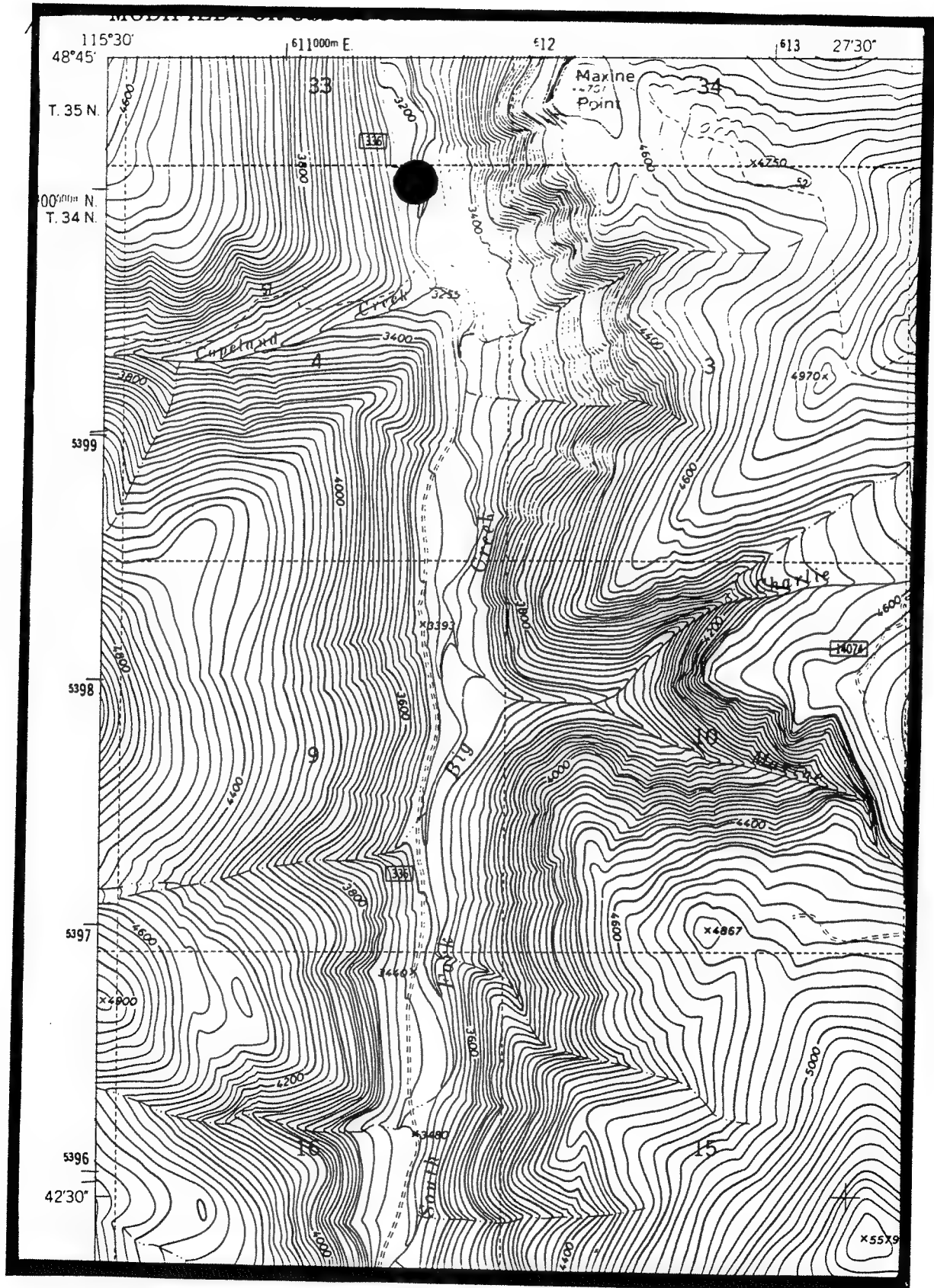
Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
SURVEYED BY JIM VANDERHORST. ECODATA PLOT #FS01140196JVOO6.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5607). 1996. MONTU.





*Botrychium montanum*; South Fork Big Creek (029)  
USGS Parsnip Mountain 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010K0.030  
Element occurrence type:

Survey site name: PARSNIP CREEK  
EO rank: A  
EO rank comments: EXCELLENT, DIVERSE GENUS COMMUNITY.

County: LINCOLN

USGS quadrangle: INCH MOUNTAIN

Township: Range: Section: TRS comments:  
034N 029W 34 SW4

Precision: S  
Survey date: 1996-09-20 Elevation: 2640 - 2680  
First observation: 1996-09-20 Slope/aspect: LEVEL  
Last observation: 1996-09-20 Size (acres): 10

Location:  
GO NORTH ALONG FS RD 228 ALONG WEST SIDE OF LAKE KOOCANUSA CA. 35  
MILES OUT OF LIBBY. FROM FS RD 228, GO UP FS RD 4838 CA. 200 YARDS TO  
SPUR ROAD. PLANTS IN CREEK BOTTOM BELOW SPUR ROAD.

Element occurrence data:  
20+ INDIVIDUALS WITH NEARLY MATURE SPORANGIA.

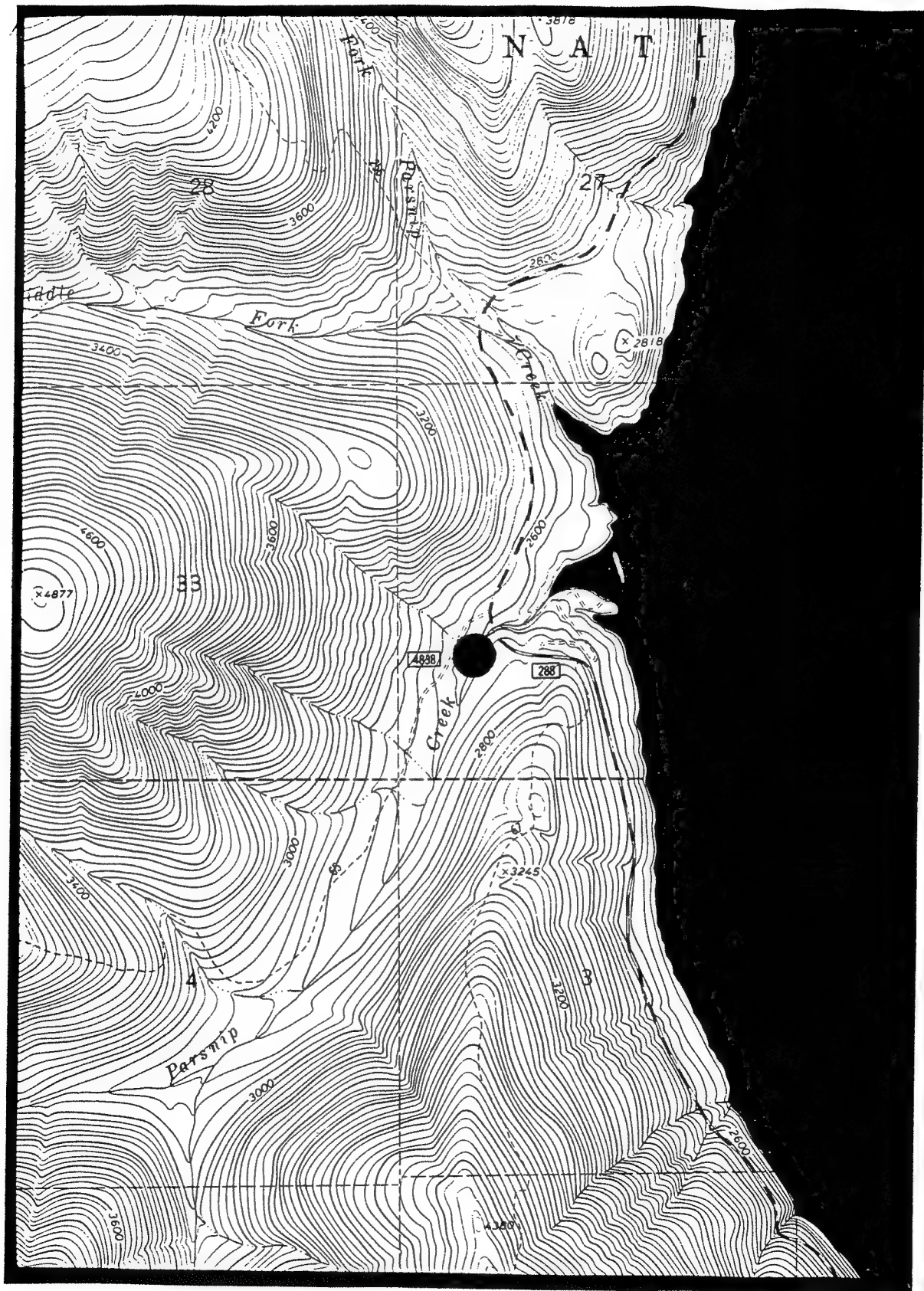
General site description:  
MOIST, SHADY BOTTOM IN A FLOODPLAIN. SOIL IS 2 INCH DUFF OVER  
SILT/DUFF LAYERS OVER ALLUVIUM. THUJA PLICATA/ATHYRIUM FILIX-FEMINA  
HT, WITH PICEA, PSEUDOTSUGA MENZIESII, LARIX OCCIDENTALIS, BETULA  
PAPYRIFERA, TIARELLA TRIFOLIATA, CLINTONIA UNIFLORA, BOTRYCHIUM  
PEDUNCULOSUM, B. LANCEOLATA, B. VIRGINIANUM, THELYPTERIS PHEGopteris.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
OBSERVED BY JIM VANDERHORST AND ANNIE DEUKER. DRAINAGE IS PROPOSED FOR  
LOGGING AND NEW ROADS IN UPLANDS; INCREASED RUNOFF COULD CAUSE  
FLOODING WHICH COULD POTENTIALLY IMPACT POPULATION.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5635). 1996. MONTU.



*Botrychium montanum*; Parsnip Creek (030)  
USGS Inch Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3      Forest Service status: SENSITIVE  
State rank: S2      Federal Status:

Element occurrence code: PPOPH010K0.031  
Element occurrence type:

Survey site name: BEETLE CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: GARVER MOUNTAIN

Township: Range: Section: TRS comments:  
036N      033W      03      NE4  
037N      033W      36      SE4

Precision: S  
Survey date:      Elevation: 4160 - 4680  
First observation: 1996-09-26      Slope/aspect: 0-5% / SOUTHEAST, EAST  
Last observation: 1996-09-26      Size (acres): 1

Location:  
FROM TROY, GO NORTH CA. 10 MILES ON HWY 2, THEN TURN ONTO HWY 508 AND  
GO CA. 23 MILES; TURN NORTH ONTO FS RD 338 AND CONTINUE 6 MILES. GO  
LEFT ON FS RD 748, NORTH ON FS RD 5919 AND CONTINUE CA. 1 MILE.  
POPULATION IS IN BEETLE CREEK AND PETE CREEK DRAINAGES.

Element occurrence data:  
26 INDIVIDUALS WITH SPORES, 3 SUBPOPULATIONS.

General site description:  
MOIST, SHADED MIDSLOPE AREA. ASSOCIATED SPECIES: THUJA PLICATA,  
OPLOPANAX HORRIDUM, CLINTONIA UNIFLORA, TSUGA HETEROPHYLLA, PINUS  
MONTICOLA, PICEA ENGELMANNII, LARIX OCCIDENTALIS, ABIES SPP.,  
PSEUDOTSUGA MENZIESII, GYMNOCARPIUM DRYOPTERIS, ATHYRIUM FILIX-FEMINA,  
CLINTONIA UNIFLORA, ADENOCaulon BICOLOR, VIOLA GLABELLA, BOTRYCHIUM  
LANCEOLATUM, B. VIRGINIANUM, GOODYERA OBLONGIFOLIA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY M. ARVIDSON AND L. SEDLER.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010K0.032  
Element occurrence type:

Survey site name: UPPER TURNER CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: LOST HORSE MOUNTAIN

Township: Range: Section: TRS comments:  
036N 030W 30 SW4NW4

Precision: S  
Survey date: Elevation: 4800 -  
First observation: 1996-08-07 Slope/aspect: 0-5% / LOW RELIEF  
Last observation: 1996-08-07 Size (acres): 1

Location:  
FROM VINAL LAKE (NEAR YAAK COMMUNITY CENTER) FOLLOW FS RD 6064 TO THE  
INTERSECTION WITH FS RD 14700. CONTINUE UP FS RD 14700 TO WHERE IT  
CROSSES TURNER CREEK AND FOLLOW THE HIKING TRAIL TO CA. HALF THE  
DISTANCE BETWEEN FS RDS 14700 AND 6064. THE POPULATION IS BOTH NEAR  
THE STREAM AND CA. 100 YARDS SOUTHWEST FROM THE TRAIL.

Element occurrence data:  
FOUR PLANTS OBSERVED, SPORES PRESENT.

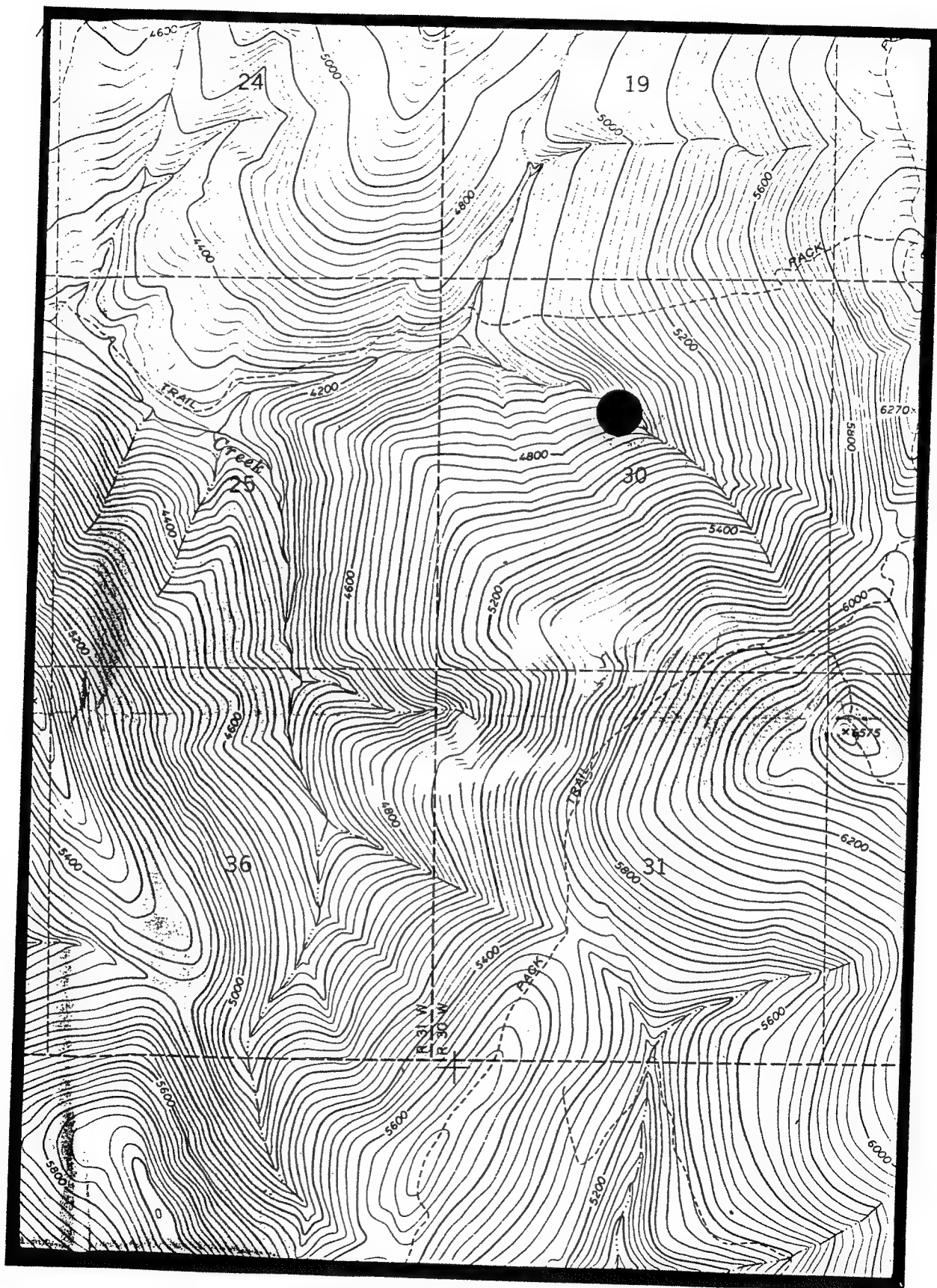
General site description:  
MOIST, SHADED BOTTOM. ASSOCIATED PLANT SPECIES INCLUDE THUJA PLICATA,  
ABIES LASIOCARPA, POPULUS TREMULOIDES, TSUGA HETEROPHYLLA, PSEUDOTSUGA  
MENZIESII, GYMNOCARPIUM DRYOPTERIS, ATHRYIUM FILIX-FEMINA, TIARELLA  
TRIDENTATA, CLINTONIA UNIFLORA, ACTAEA RUBRA, GALIUM TRIFLORUM.  
ADDITIONAL PLANT ASSOCIATES INCLUDE: LISTERA CAURINA, ARNICA  
LATIFOLIA, OPILOPANAX HORRIDUM, BOTRYCHIUM MINGANENSE.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY MICHAEL ARVIDSON.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:



*Botrychium montanum*; Upper Turner Creek (032)  
USGS Lost Horse Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Element occurrence code: PPOPH010K0.033  
Element occurrence type:

Survey site name: NORTH FORK MEADOW CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: MOUNT BALDY

Township: Range: Section: TRS comments:  
035N 034W 11 SW4, SE4; 14 NE4, NW4; 13 NW4

Precision: S  
Survey date: Elevation: 3780 - 4760  
First observation: 1996-09-23 Slope/aspect: 0-10% / NORTHEAST  
Last observation: 1996-09-23 Size (acres): 3

Location:  
CA. 11 AIR MILES WEST OF YAAK. ALL 6 SUBPOPULATIONS ARE LOCATED UP  
NORTH FORK MEADOW CREEK. ACCESS VIA FS RD 5961.

Element occurrence data:  
18 PLANTS OBSERVED IN 6 SUBPOPULATIONS; SPORES PRESENT.

General site description:  
MOIST, SHADED BOTTOM, WITH THUJA PLICATA, TSUGA HETEROPHYLLA, PINUS  
MONTIGOLA, ABIES BIFLORA, LARIX OCCIDENTALIS, CLINTONIA UNIFLORA,  
PYROLA SECUNDA, TIARELLA TRIDENTATA, GOODYERA OBLONGIFOLIA, ACTAEA  
RUBRA, OPILOPANAX HORRIDUM, VACCINIUM MEMBRANACEUM, MENZIESIA  
FERRUGINEA, BOTRYCHIUM LANCEOLATUM, B. MINGANENSE, ATHYRIUM  
FILIX-FEMINA, DRYOPERIS AUSTRIACA, LYCOPODIUM ANNOTINUM, HUPERZIA  
OCCIDENTALIS, GYMNOCARPUM DRYOPTERIS.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY M. ARVIDSON. SOME HERBIVORY NOTED.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL  
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:







Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM MONTANUM  
Common Name: MOUNTAIN MOONWORT

Global rank: G3      Forest Service status: SENSITIVE  
State rank: S2      Federal Status:

Element occurrence code: PPOPH010K0.034  
Element occurrence type:

Survey site name: ARBO CREEK  
EO rank: C  
EO rank comments: SMALL POPULATION.

County: LINCOLN

USGS quadrangle: SYLVANITE

Township: Range: Section: TRS comments:  
033N      033W      14      NW4

Precision: S  
Survey date: 1996-08-14      Elevation: 3420 -  
First observation: 1996-08-14      Slope/aspect: LEVEL  
Last observation: 1996-08-14      Size (acres): 5

Location:  
SOUTH OF YAAK FALLS ON ARBO CREEK. FROM EAST SIDE ROAD (FS RD 176)  
FOLLOW FS ROAD 2367 CA. 2.5 MILES TO SPUR ROAD WHICH CROSSES ARBO  
CREEK. POPULATION IS DOWNSTREAM FROM BRIDGE.

Element occurrence data:  
ONE PLANT OBSERVED, WITH MATURE SPORANGIA.

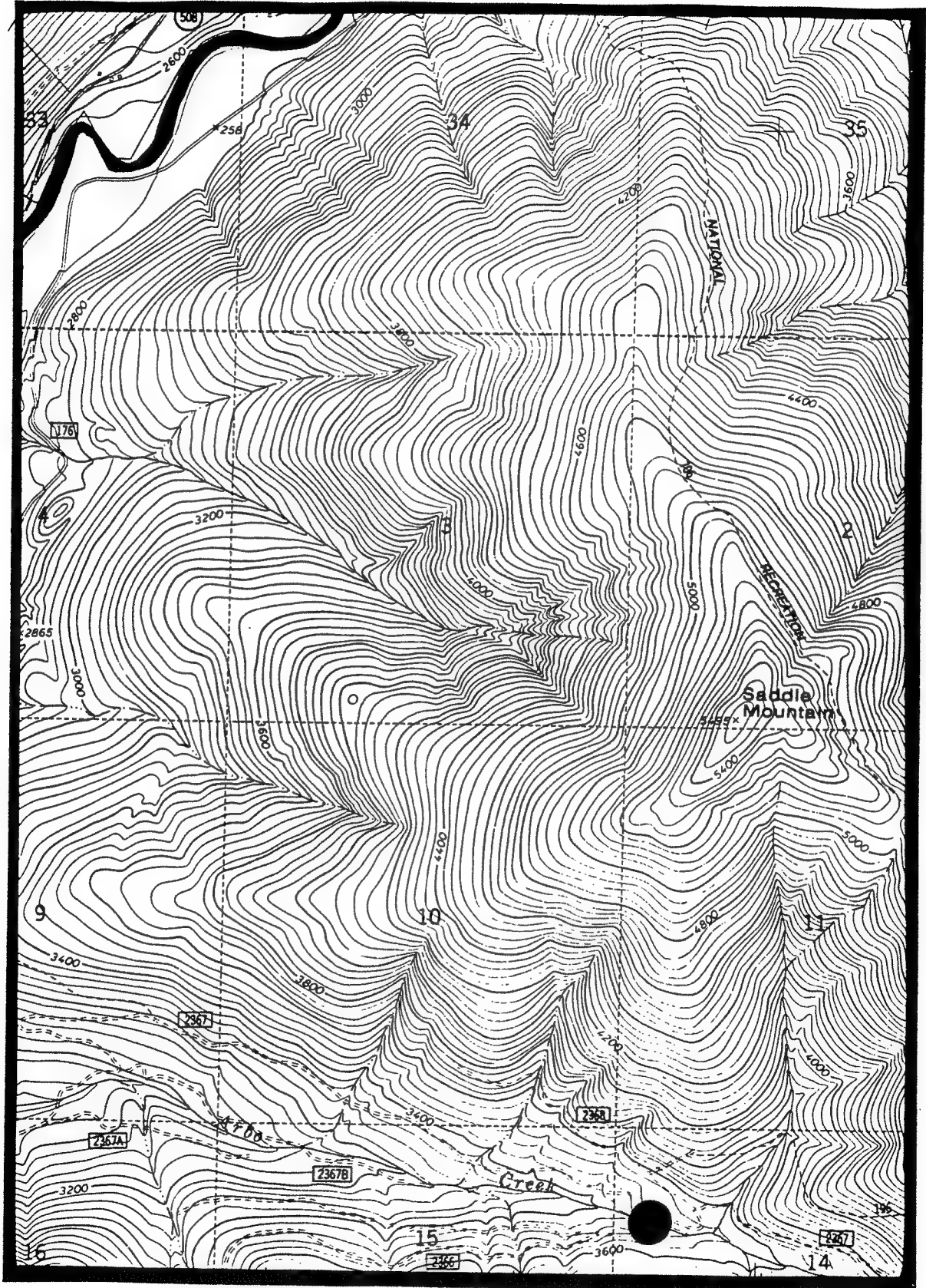
General site description:  
MOIST, SHADED BOTTOM, ORGANIC LAYER OVER GLACIAL ALLUVIUM. ASSOCIATED  
PLANTS INCLUDE THUJA PLICATA, TSUGA HETEROPHYLLA, OPILODONTIS HORRIDUM,  
CLINTONIA UNIFLORA. ADDITIONAL PLANT ASSOCIATES INCLUDE PSEUDOTSUGA  
MENZIESII, GYMNOCARPIUM DRYOPTERIS, TIARELLA TRIFOLIATA, RHYTHIDOPSIS  
ROBUSTA, SMILACINA STELLATA, ORTHILLIA SECUNDA, DRYOPTERIS DILATATA.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY JIM VANDERHORST. POPULATION SURROUNDED BY CLEARCUTS AND  
ROADS; STREAM BOTTOM SELECTIVELY LOGGED IN PAST. MINOR HERBIVORY.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



*Botrychium montanum*; Arbo Creek (034)  
USGS Sylvanite 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM PARADOXUM  
Common Name: PECULIAR MOONWORT

Global rank: G2      Forest Service status: SENSITIVE  
State rank: S1      Federal Status:

Element occurrence code: PPOPH010J0.008  
Element occurrence type:

Survey site name: CAN CREEK DRAINAGE  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: PINK MOUNTAIN

Township: Range: Section: TRS comments:  
035N      031W      32      SE4

Precision: S  
Survey date: 1996-08-13      Elevation: 4280 - 4440  
First observation: 1993-07-30      Slope/aspect: 50% / NORTH-NW  
Last observation: 1993-07-30      Size (acres):

Location:  
IN DRAW OF CAN CREEK DRAINAGE, CA. 2.1 AIR MILES WNW OF PINK MOUNTAIN  
AND CA. 8 MILES SOUTHEAST OF YAAK.

Element occurrence data:  
1 B. PARADOXUM PLANT SEEN IN 1993; NOT SEEN IN SUBSEQUENT SURVEYS.

General site description:  
IN GENUS COMMUNITY MADE UP OF B. MINGANENSE, B. MONTANUM, AND ONE  
PLANT OF B. PARADOXUM. MOIST, PARTIALLY SHADED LOWERSLOPE/BOTTOM.  
LANDTYPE 352. WESTERN HEMLOCK/CLINTONIA UNIFLORA/CLINTONIA UNIFLORA  
HABITAT TYPE. MATURE WESTERN RED CEDAR OVERSTORY. ASSOCIATED SPECIES:  
RIBES LACUSTRE, BERBERIS REPENS, ASTER SPP., ROSA GYMNOCARPA, VIOLA  
ORBICULATA, LINNAEA BOREALIS, SPIRAEA BETULIFOLIA, VACCINIUM  
SCOPARIUM, CHIMAPHILA UMBELLATA, LONICERA UTAHENSIS, SMILACINA  
STELLATA, OSMORHIZA CHILENSIS. COMPLETE LIST ON FILE AT MTHP.

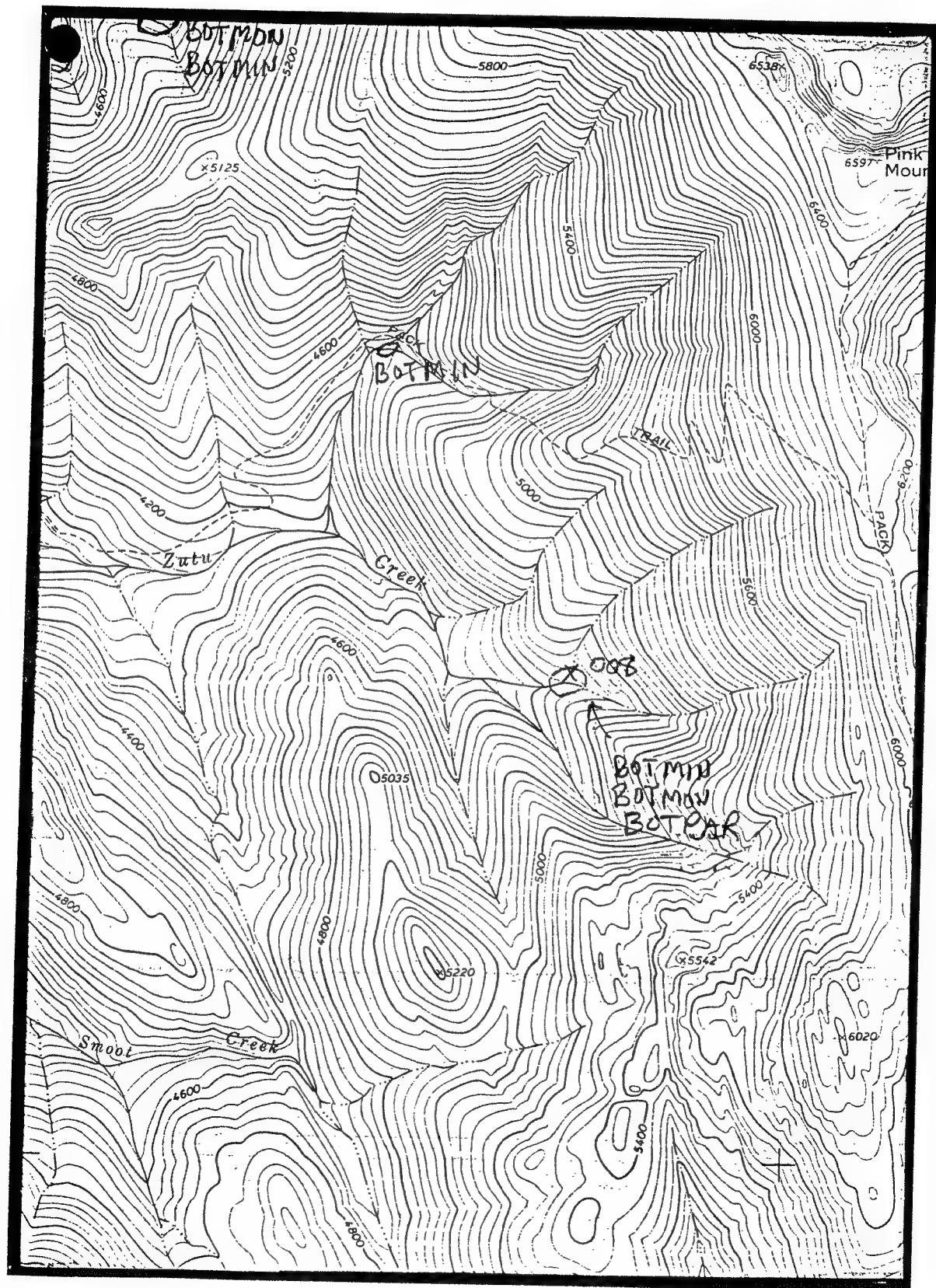
Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
VERIFICATION FROM W. H. WAGNER IS PENDING. OBSERVED BY LESLIE  
FERGUSON. SITE MAY HAVE CEDAR TYPE MICROSITES. REVISITED IN 1995 AND  
1996 BY J. VANDERHORST; ONLY B. MONTANUM WAS FOUND, ONE PLANT WITH  
TROPHOPHORE BEARING SPORANGIA MIGHT BE MISTAKEN FOR B. PARADOXUM.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:

Botrychium paradoxum; Can Creek Drainage (008)  
USGS Pink Mountain 7.5' quadrangle  
(upper left corner)



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM PARADOXUM  
Common Name: PECULIAR MOONWORT

Global rank: G2      Forest Service status: SENSITIVE  
State rank: S1      Federal Status:

Element occurrence code: PPOPH010J0.009  
Element occurrence type:

Survey site name: CAN CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: FLATIRON MOUNTAIN

Township:	Range:	Section:	TRS comments:
035N	031W	32	SW4
034N	031W	5	NW4

Precision:	S	
Survey date:		Elevation: 3720 - 3840
First observation:	1993-07-29	Slope/aspect: 0% / WNW
Last observation:	1995-09-05	Size (acres): 3

Location:  
CA. 1.8 AIR MILES NORTHEAST OF CLAY MOUNTAIN ON SOUTH SIDE OF CAN  
CREEK, CA. 0.5 MILE FROM MOUTH. SITE IS OFF PIPE CREEK ROAD.

Element occurrence data:  
1995: ONLY B. MONTANUM AND B. MINGANENSE FOUND. 1993: 1 PLANT B.  
PARADOXUM WITH SPOROPHORES.

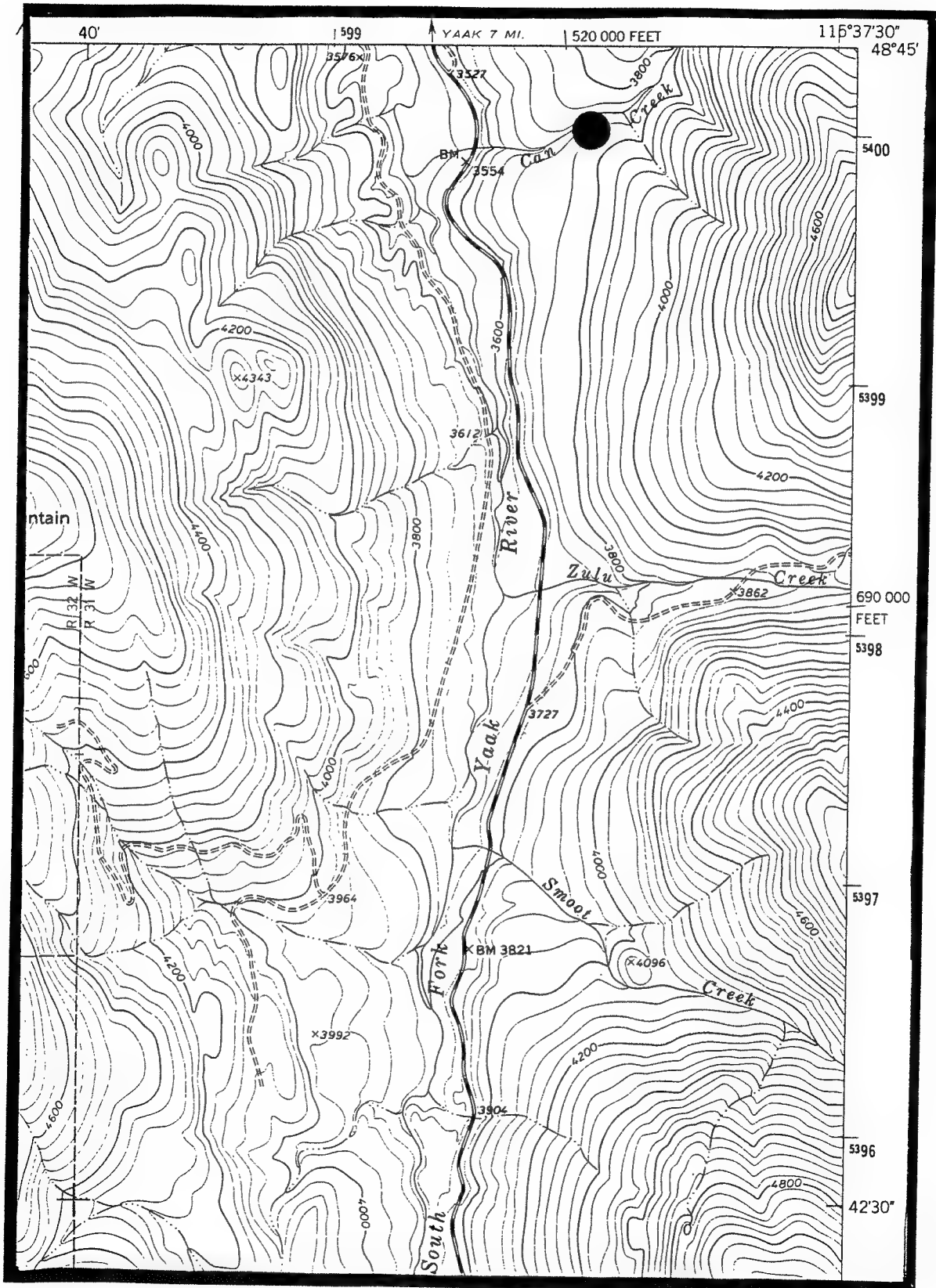
General site description:  
IN GENUS COMMUNITY MADE UP OF B. MINGANENSE, B. MONTANUM, AND ONE  
PLANT OF B. PARADOXUM. MOIST, SHADED LOWERSLOPE/BOTTOM. LANDTYPE 352.  
OLD GROWTH WESTERN RED CEDAR OVERSTORY. THICK DUFF. WESTERN  
HEMLOCK/CLINTONIA UNIFLORA/CLINTONIA UNIFLORA HABITAT TYPE. ASSOCIATED  
SPECIES: LINNAEA BOREALIS, PYROLA CHLORANTHA, TRILLIUM OVATUM, LISTERA  
SP., MENZIESIA FERRUGINEA, CAREX GEYERI, PAXISTIMA MYRSINITES,  
BERBERIS REPENS, AMELANCHIER ALNIFOLIA, SMILACINA RACEMOSA, LUPINE  
SP., SPIRAEA BETULIFOLIA, MELAMPYRUM LINEARE. COMPLETE LIST ON FILE AT  
MTHP.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY LESLIE FERGUSON. SITE REVISITED IN 1995 BY J. VANDERHORST,  
L. FERGUSON, AND M. ARVIDSON. NO PHOTOS OR SPECIMENS.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



Botrychium paradoxum; Can Creek (009)  
USGS Flatiron Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM PARADOXUM  
Common Name: PECULIAR MOONWORT

Global rank: G2 Forest Service status: SENSITIVE  
State rank: S1 Federal Status:

Element occurrence code: PPOPH010J0.010  
Element occurrence type:

Survey site name: ZULU CREEK  
EO rank:  
EO rank comments:

County: LINCOLN

USGS quadrangle: PINK MOUNTAIN

Township: Range: Section: TRS comments:  
034N 031W 10 SW4

Precision: S  
Survey date: 1996-09-03 Elevation: 4640 -  
First observation: 1995-08-09 Slope/aspect: 0-5% / -  
Last observation: 1995-08-09 Size (acres): 10

Location:  
ZULU CREEK, CA. 9 AIR MILES SOUTHWEST OF YAAK. FROM FS RD 68, DRIVE UP  
FS RD 6079 CA. 3 MILES, TURN RIGHT ON SPUR ROAD, AND FOLLOW CA. 2  
MILES TO THIRD TRIBUTARY CROSSING. PLANTS ARE IN CREEK BOTTOM ABOVE  
ROAD AND CLEARCUTS.

Element occurrence data:  
1996: POPULATION NOT RELOCATED. 9 AUGUST 1995: ONE BOTRYCHIUM  
PARADOXUM PLANT IN GENUS COMMUNITY, 100% IMMATURE SPOROPHORES.

General site description:  
MOIST TO SATURATED, MOSSY, SHADED, GLACIATED VALLEY BOTTOM. LANDTYPE  
357. ALLUVIUM PARENT MATERIAL, ORGANIC DUFF SOIL. THUJA  
PLICATA/CLINTONIA UNIFLORA HABITAT TYPE. ASSOCIATED SPECIES: TIARELLA  
TRIFOLIATA, PICEA ENGELMANII, VERONICA AMERICANA, HABENARIA SACCATA,  
ACTAEA RUBRA, PSEUDOTSUGA MENZIESII, LARIX OCCIDENTALIS, ORTHILLA  
SECUNDA, MONESUS UNIFLORA, BOTRYCHIUM MONTANUM, BOTRYCHIUM MINGANENSE,  
BOTRYCHIUM VIRGINIANUM.

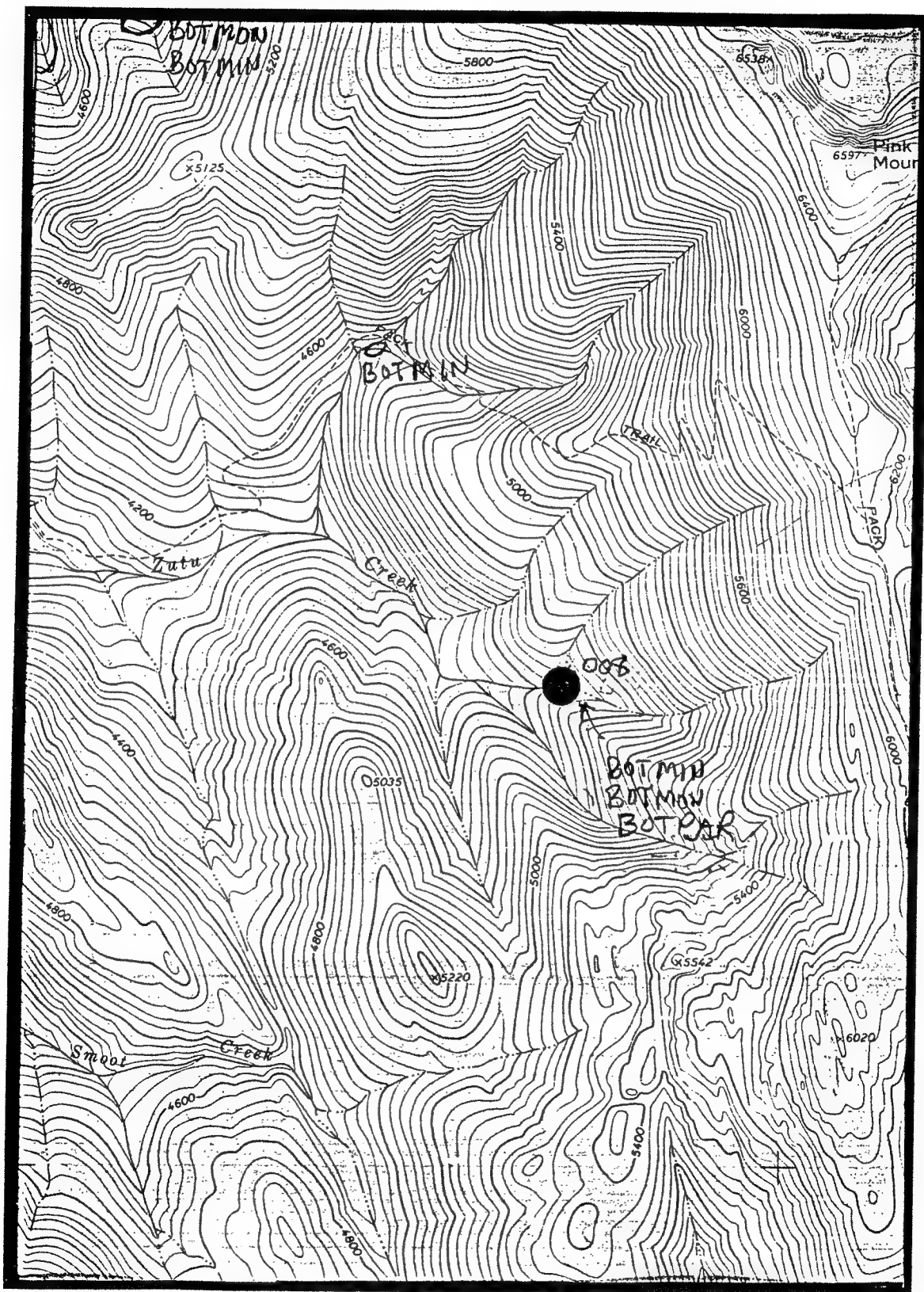
Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST, M. ARVIDSON, AND L. SEDLER. DISTURBANCE BY  
LARGE WINDFALL, LEAVING POOLS OF SURFACE WATER. SITE WAS SAMPLED FOR  
PLANT COMPOSITION USING REPLICATED MICROPLOTS. ECODATA PLOT  
#FS01140395JV008.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5521). 1995. MONTU.





Botrychium paradoxum; Zulu Creek (010)  
USGS Pink Mountain 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM PEDUNCULOSUM  
Common Name: STALKED MOONWORT

Global rank: G3? Forest Service status:  
State rank: S1 Federal Status:

Element occurrence code: PPOPH010T0.001  
Element occurrence type:

Survey site name: SOUTH FORK BIG CREEK  
EO rank: A  
EO rank comments: SCARCE, BUT PLANTS WITH HIGH VIGOR.

County: LINCOLN

USGS quadrangle: PARSNIP MOUNTAIN

Township: Range: Section: TRS comments:  
034N 030W 04 NE4

Precision: S  
Survey date: 1996-07-24 Elevation: 3200 -  
First observation: 1996-07-24 Slope/aspect: LEVEL  
Last observation: 1996-07-24 Size (acres): 10

Location:  
FROM EUREKA, GO WEST ON HWY 37 CA. 10 MILES, THEN CROSS KOOTENAI RIVER  
AND CONTINUE SOUTH OF FS RD 228 CA. 7 MILES. GO WEST OF FS RD 336 CA.  
7 MILES; SITE IS CA. 0.3 MILE DOWNSTREAM FROM CONFLUENCE WITH COPELAND  
CREEK.

Element occurrence data:  
8 PLANTS, 100% WITH IMMATURE SPORANGIA.

General site description:  
MOIST, SHADY BOTTOM ON AN UNDULATING FLOODPLAIN SLOPE. THUJA  
PLICATA/OPLOPANAX HORRIDUM HT, WITH ABIES LASIOCARPA, TAXUS  
BREVIFOLIA, TIARELLA TRIFOLIATA, CLINTONIA UNIFLORA, BOTRYCHIUM  
VIRGINIANUM, B. MONTANUM, B. MINGANENSE, AND B. LANCEOLATUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
STATE RECORD FOR SPECIES. FLOODING MAY AFFECT POPULATION BUT REPLENISH  
HABITAT. POTENTIAL HABITAT DISTURBED BY FLOODING IN SPRING, 1996  
(CULVERT DRAINAGE INTO POPULATION AREA FROM ROAD ABOVE). ECODATA PLOT  
FS01140196006. OBSERVED BY J. VANDERHORST IN 1996.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5609). 1996. MONTU.



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM PEDUNCULOSUM  
Common Name: STALKED MOONWORT

Global rank: G3? Forest Service status:  
State rank: S1 Federal Status:

Element occurrence code: PPOPH010T0.002  
Element occurrence type:

Survey site name: PARSNIP CREEK  
EO rank: A  
EO rank comments: EXCELLENT, DIVERSE GENUS COMMUNITY BUT ONLY ONE B.  
PEDUNCULOSUM SEEN.

County: LINCOLN

USGS quadrangle: INCH MOUNTAIN

Township: Range: Section: TRS comments:  
034N 029W 34 W2SW4

Precision: S  
Survey date: 1996-09-20 Elevation: 2600 - 2680  
First observation: 1996-09-20 Slope/aspect: LEVEL  
Last observation: 1996-09-20 Size (acres): 10

Location:  
FROM EUREKA GO WEST ON HWY 37 CA. 10 MILES, CROSS THE KOOTENAI RIVER  
AND CONTINUE SOUTH ON THE WEST SIDE ON FS RD 228 CA. 12.5 MILES. TAKE  
FS RD 4838 CA. 200 YARDS TO SPUR ROAD. PLANTS ARE IN CREEK BOTTOM  
BELOW THE ROAD.

Element occurrence data:  
1 PLANT WITH MATURE SPORANGIA.

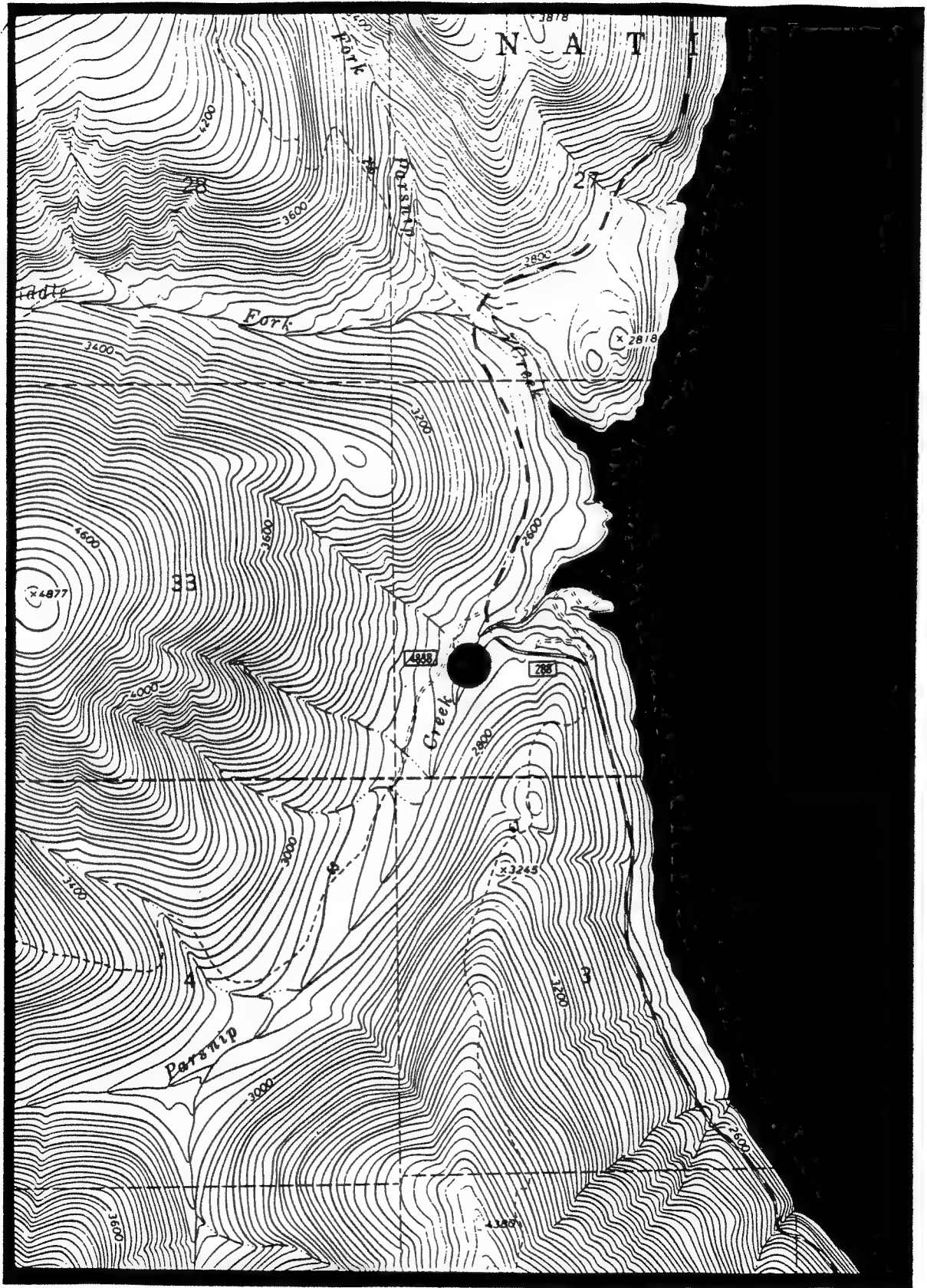
General site description:  
MOIST, SHADY BOTTOM OF FLOODPLAIN, 2-INCH DUFF OVER SILT/DUFF,  
ALLUVIUM PARENT. THUJA PLICATA/ATHYRIUM FILIX-FEMINA HT, WITH PICEA,  
PSEUDOTSUGA MENZIESII, LARIX OCCIDENTALIS, BETULA PAPYRIFERA, TIARELLA  
TRIFOLIATA, CLINTONIA UNIFLORA, BOTRYCHIUM PEDUNCULOSUM, B.  
MINGANENSE, B. MONTANUM, B. LANCEOLATA, B. VIRGINIANUM, THELYPTERIS  
PHEGopteris.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST AND A. DEUKER IN 1996. FLOODING OF LOWER  
CHANNELS IN WINTER/SPRING OF 1996. DRAINAGE IS PROPOSED FOR LOGGING  
AND NEW ROADS IN UPLANDS; INCREASED RUNOFF COULD POTENTIALLY AFFECT  
POPULATION.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



*Botrychium pedunculatum*; Parsnip Creek (002)  
USGS Inch Mountain 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM PEDUNCULOSUM  
Common Name: STALKED MOONWORT

Global rank: G3? Forest Service status:  
State rank: S1 Federal Status:

Element occurrence code: PPOPH010T0.003  
Element occurrence type:

Survey site name: KEELER CREEK  
EO rank: C  
EO rank comments: JUST THREE PLANTS, SMALL AREA OF HABITAT.

County: LINCOLN

USGS quadrangle: SPAR LAKE

Township: Range: Section: TRS comments:  
030N 034W 28 W2SW4NW4; 29 E2SE4NE4

Precision: S  
Survey date: 1996-07-25 Elevation: 2880 -  
First observation: 1996-07-25 Slope/aspect: LEVEL  
Last observation: 1996-09-19 Size (acres): 1

Location:  
FROM TROY GO SOUTHEAST ON HWY 2 CA. 2 MILES, THEN SOUTH ON FS RD 384  
CA. 6 MILES. GO WEST ONTO FS RD 473 TO MILEMARKER 6, THEN GO SOUTH TO  
KEELER CREEK. PLANTS ARE IN CEDAR GROVE ON NORTH SIDE OF CREEK.

Element occurrence data:  
1 PLANT WITH IMMATURE SPORANGIA, 2 MORE PLANTS FOUND ON 9/19, WITH  
SPORES DISPERSED.

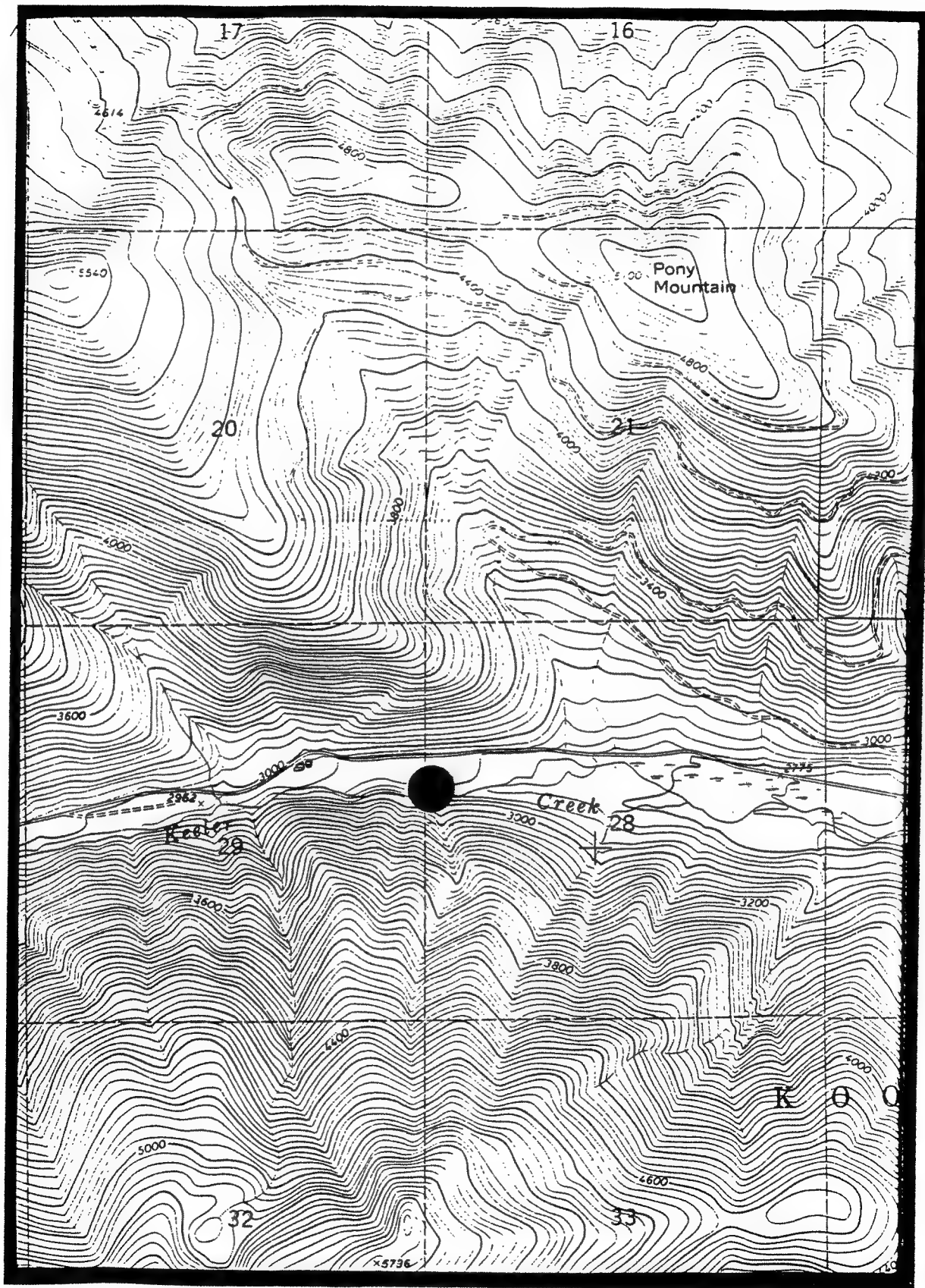
General site description:  
MOIST, SHADY FLOODPLAIN BOTTOM ON UNDULATING SLOPE. SOIL IS 2-INCH  
DUFF OVER SILTY ALLUVIUM WITH ALLUVIUM PARENT. THUJA PLICATA/OPLOPANAX  
HORRIDUM HT, WITH TIARELLA TRIFOLIATA, ATHYRIUM FILIX-FEMINA,  
GYMNOCARPIUM DRYOPTERIS, SMILACINA STELLATA, BOTRYCHIUM LANCEOLATUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST AND L. FERGUSON. POTENTIAL HABITAT FLOODED  
IN SPRING, 1996.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:



*Botrychium pedunculatum*; Keeler Creek (003)  
USGS Spar Lake 7.5' quadrangle

Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM PEDUNCULOSUM  
Common Name: STALKED MOONWORT

Global rank: G3? Forest Service status:  
State rank: S1 Federal Status:

Element occurrence code: PPOPH010T0.004  
Element occurrence type:

Survey site name: SUTTON CREEK  
EO rank: B  
EO rank comments: ONLY ONE PLANT IN FLOODED AREA.

County: LINCOLN

USGS quadrangle: BEARTRAP MOUNTAIN

Township: Range: Section: TRS comments:  
035N 028W 33 NE4

Precision: S  
Survey date: 1995-09-23 Elevation: 3080 -  
First observation: 1995-09-23 Slope/aspect:  
Last observation: 1995-09-23 Size (acres): 1

Location:  
FROM HWY 37 ON THE EAST SIDE OF LAKE KOOCANUSA, TAKE FS RD 619 UP  
SUTTON CREEK CA. 3.1 MILES TO SWITCHBACK. SITE IS IN CREEK BOTTOM TO  
SOUTH.

Element occurrence data:  
ONE PLANT FOUND, WITH MATURE SPORANGIA.

General site description:  
MOIST, SHADED BOTTOM, 2-INCH DUFF OVER SILT ON ALLUVIUM. THUJA  
PLICATA/OPLOPANAX HORRIDUM HT, WITH POPULUS BALSAMIFERA, BOTRYCHIUM  
VIRGINIANUM, B. MONTANUM, B. LANCEOLATUM, AND B. MINGANENSE.

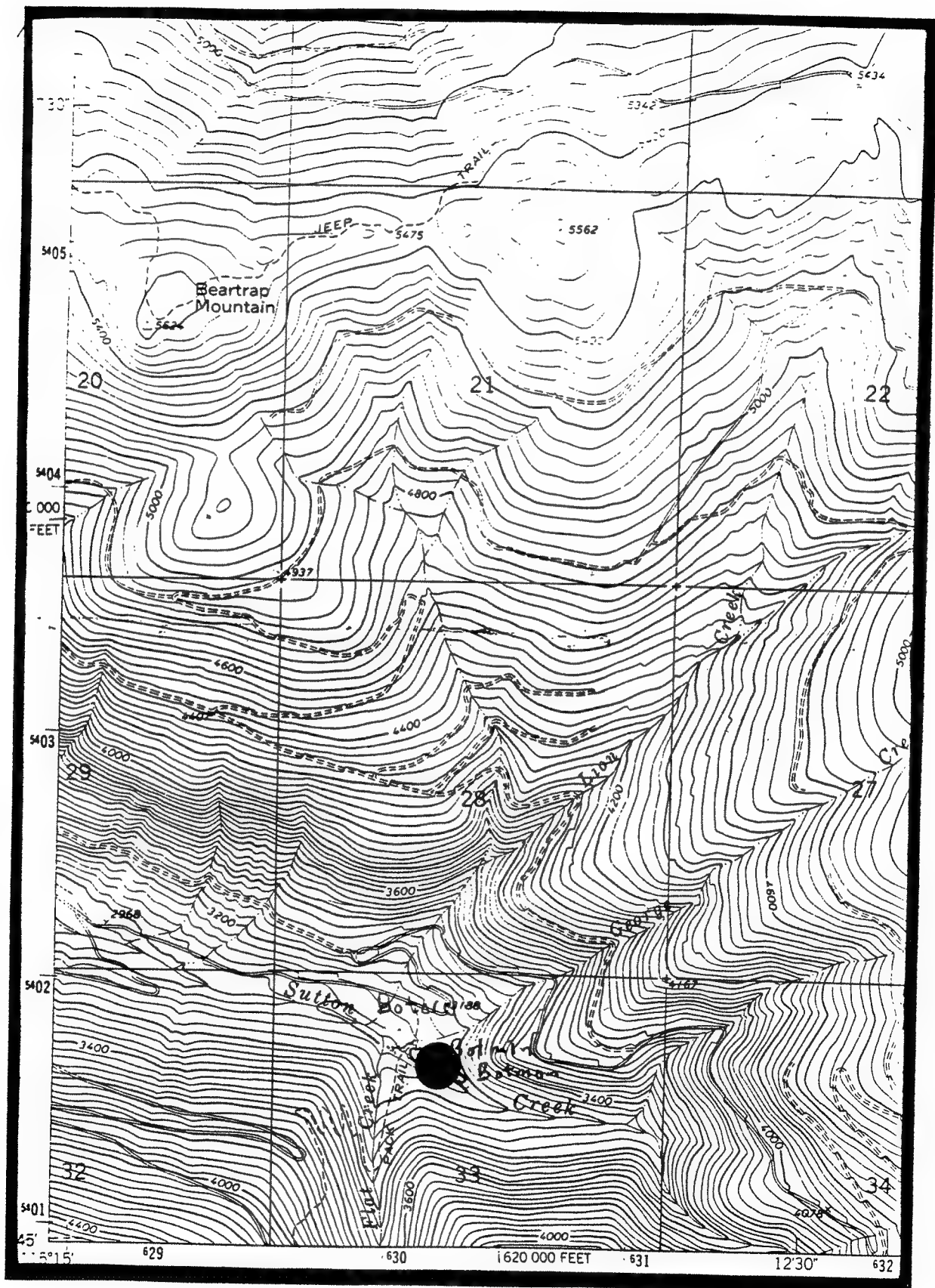
Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST AND L. EVANS. LOWER FLOODPLAIN CHANNELS  
FLOODED IN 1996, POSSIBLY AFFECTING PAST POPULATION AREA.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens:





*Botrychium pedunculatum*; Sutton Creek (004)  
USGS Beartrap Mountain 7.5' quadrangle



Montana Natural Heritage Program  
Element Occurrence Record

Scientific Name: BOTRYCHIUM PEDUNCULOSUM  
Common Name: STALKED MOONWORT

Global rank: G3? Forest Service status:  
State rank: S1 Federal Status:

Element occurrence code: PPOPH010T0.005  
Element occurrence type:

Survey site name: BIG CREEK  
EO rank: B  
EO rank comments: FEW PLANTS, BUT HIGH VIGOR IN SMALL, REMNANT  
OLD-GROWTH.

County: LINCOLN

USGS quadrangle: BOULDER LAKES

Township: Range: Section: TRS comments:  
035N 030W 35 NW4

Precision: S  
Survey date: 1996-08-09 Elevation: 3020 -  
First observation: 1996-08-09 Slope/aspect:  
Last observation: 1996-08-09 Size (acres): 1

Location:  
TRAVEL UP BIG CREEK FROM LAKE KOOCANUSA ON FS RD 336 CA. 5 MILES TO  
GOOD CREEK CROSSING. WALK SOUTH AND FORD BIG CREEK. POPULATION IS IN  
OLD-GROWTH CEDAR ON THE SOUTH SIDE OF CREEK.

Element occurrence data:  
5 PLANTS, SPORANGIA NEARLY MATURE, ONE PLANT DISPERSING SPORES.

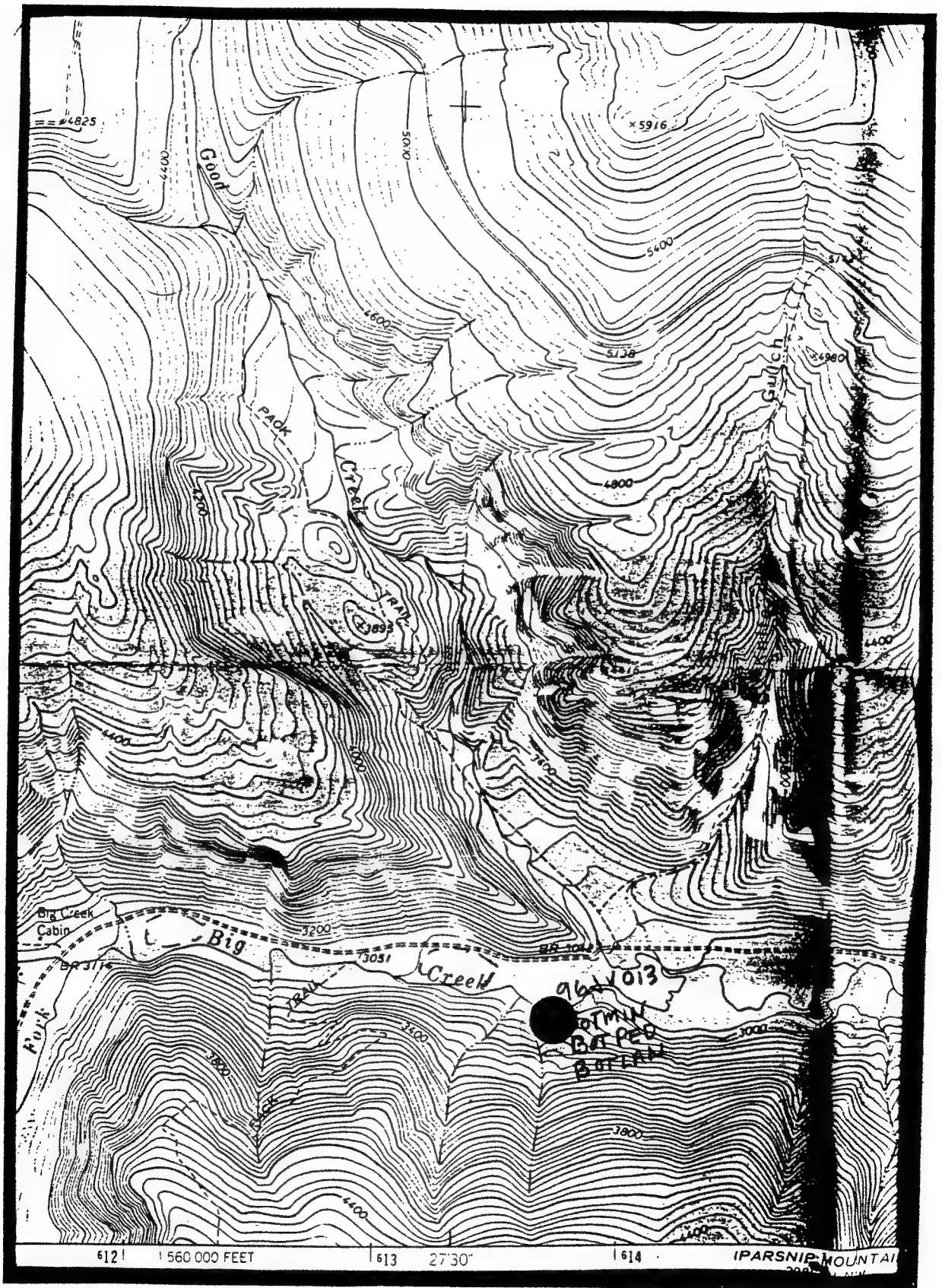
General site description:  
MOIST, SHADED BOTTOM, 2-INCH LITTER OVER SILTY ALLUVIUM ON FLOODPLAIN.  
THUJA PLICATA/OPLOPANAX HORRIDUM HT, WITH CLINTONIA UNIFLORA, PICEA  
SPP., PSEUDOTSUGA MENZIESII, ACER GLABRUM, TIARELLA TRIFOLIATA,  
CIRCAEA ALPINA, GYMNOCARPIUM DRYOPTERIS, BOTRYCHIUM LANCEOLATUM, B.  
MINGANENSE AND B. VIRGINIANUM.

Land owner/manager:  
KOOTENAI NATIONAL FOREST, REXFORD RANGER DISTRICT

Comments:  
OBSERVED BY J. VANDERHORST. SILT DEPOSITION FROM 1996 SPRING FLOODING  
IN LOWER POTENTIAL HABITAT--NO BOTRYCHIUM FOUND IN THIS AREA. COLOR  
PHOTOCOPY OF SPECIMEN VERIFIED BY W. H. WAGNER.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,  
MT 59935.

Specimens: VANDERHORST, J. (5617). 1996. MONTU.



*Botrychium pedunculatum*; Big Creek (005)  
USGS Boulder Lakes 7.5' quadrangle

\*\*\*\* summary of input values entered into the program \*\*\*\*

97/01/31

title: KOOTENAI MOONWORKS

output file name: STRATA.OUT

ecodata plot file: MOON.STR

program version number: 4.01

species abundance values: (1-cover, 2-plant volume, 3-biomass, 4-relative cover ): 1

site table (1-no site table, 2-selected site table, 3-complete site table): 2  
items in condensed site table:

- |                               |                               |
|-------------------------------|-------------------------------|
| 1) plot key id number         | 2) formation                  |
| 3) series (first ind spp)     | 4) habitat type (2nd spp)     |
| 5) dominant life form         | 6) live life form size class  |
| 7) live canopy cover class    | 8) upper layer dom species 1  |
| 9) upper layer dom species 2  | 10) mid layer dom species 1   |
| 11) mid layer dom species 2   | 12) lower layer dom species 1 |
| 13) lower layer dom species 2 | 14) special features          |
| 15) geomorphic landform       | 16) surficial geology         |
| 17) plot position             | 18) slope shape (vertical)    |
| 19) slope shape (horizontal)  | 20) elevation (ft msl)        |
| 21) aspect (azimuths)         | 22) slope (%)                 |
| 23) bare ground cover (%)     | 24) gravel ground cover (%)   |
| 25) rock ground cover (%)     | 26) litter ground cover (%)   |
| 27) woody ground cover (%)    | 28) bryophyte ground cov (%)  |
| 29) basal veg cover (%)       | 30) water cover (%)           |
| 31) fuel loading class-model  | 32) duff-litter depth (in)    |
| 33) live basal area (sqft/ac) | 34) live tree dbh (in)        |
| 35) ave live tree height (ft) | 36) dominant tree age (yr)    |
| 37) tree total cover (%)      | 38) tree seedling cover (%)   |
| 39) tree sapling cover (%)    | 40) tree pole cover (%)       |
| 41) tree medium cover (%)     | 42) tree large cover (%)      |
| 43) tree very large cover (%) | 44) shrub total cover (%)     |
| 45) grass total cover (%)     | 46) forb total cover (%)      |
| 47) fern total cover (%)      | 48) bryophyte total cover (%) |

cover tables (1-no tables, 2-syn table, 3-con/ave table, 4-both tables): 4

method of species limitation -- use species with life form: 1

method of species limitation -- use species with life form: 2

method of species limitation -- use species with life form: 3

method of species limitation -- use species with life form: 4

method of species limitation -- use species with life form: 5

pseudospecies: (1-no pseudospp, 2-tree pseudospp, 3-shrub pseudospp, 4-both): 1  
number continuous variables per strata printed in site variable table: 32

types of continuous site variables in table:

- |                             |                            |
|-----------------------------|----------------------------|
| 1) elevation (ft msl)       | 2) aspect (azimuths)       |
| 3) slope (%)                | 4) bare ground cover (%)   |
| 5) gravel ground cover (%)  | 6) rock ground cover (%)   |
| 7) litter ground cover (%)  | 8) woody ground cover (%)  |
| 9) bryophyte ground cov (%) | 10) basal veg cover (%)    |
| 11) water cover (%)         | 12) duff-litter depth (in) |

13) dominant layer ave hgt  
 15) live tree dbh (in)  
 17) dominant tree age (yr)  
 19) tree seedling cover (%)  
 21) tree pole cover (%)  
 23) tree large cover (%)  
 25) shrub total cover (%)  
 27) shrub mid cover (%)  
 29) gram. total cover (%)  
 31) fern total cover (%)  
 14) live basal area(sqft/ac)  
 16) ave live tree height(ft)  
 18) tree total cover (%)  
 20) tree sapling cover (%)  
 22) tree medium cover (%)  
 24) tree very large cover (%)  
 26) low shrub cover (%)  
 28) shrub tall cover (%)  
 30) forb total cover (%)  
 32) bryophyte total cover (%)

number categorical variables per strata printed in site variable table: 21  
 types of categorical site variables in table:

1) vegetation formation  
 3) pvc indicator species 2  
 5) pvc site phase  
 7) live life form size class  
 9) live life form cover cls  
 11) middle layer dominant spp  
 13) special features  
 15) surficial geology  
 17) vertical slope shape  
 19) erosion status  
 21) fuel loading class  
 2) pvc indicator species 1  
 4) pvc indicator species 3  
 6) dominant life form  
 8) dead life form size class  
 10) upper layer dominant spp  
 12) lower layer dominant spp  
 14) geomorphic landform  
 16) plot position  
 18) horizontal slope shape  
 20) erosion type

diversity calculations included (0=no, 1=yes): 1

similarity tables (1=no sim, 2-plot sim, 3-strata sim, 4-plot to strata sim, 5-all three tables): 0

write to other databases (1=no write, 2-system write, 3-ecoclass write, 4-both): 1

\*\*\*\*\* entered plot key-ids \*\*\*\*\*

----) strata name: BOTASC

1 FS01140395JV002 2 FS01140596JV008 3 FS01140596JV007

----) strata name: BOTCRE

1 FS01140694JR001 2 FS01140596JV002 3 FS01140395JV002 4 FS01140596JV012 5 FS01140396JV004  
 6 FS01140194EK001

----) strata name: BOTMLN

1 FS01140694JR002 2 FS01140395TT102 3 FS01140296JV003 4 FS01140596JV008 5 FS01140296JV009  
 6 FS01140796JV014 7 FS01140496JV017 8 FS01140496JV015 9 FS01140196JV006 10 FS01140295JV006  
 11 FS01140495JV008 12 FS01140296JV001 13 FS01140296JV005 14 FS01140296JV010 15 FS01140196JV013  
 16 FS01140596JV011 17 FS01140396TS315 18 FS01140396TS055

----) strata name: BOTMON

1 FS01140295JV006 2 FS01140296JV001 3 FS01140296JV005 4 FS01140296JV010 5 FS01140296JV003  
 6 FS01140596JV007 7 FS01140596JV011 8 FS01140196JV006 9 FS01140495JV008 10 FS01140496JV016  
 11 FS01140396TS313

----) strata name: BOTPAR

1 FS01140495JV008      2 FS01140296JV010      3 FS01140496JV016

-----) strata name: BOTPED

1 FS01140196JV013      2 FS01140196JV006

[illegible]

\*\*\*\*\* SITE DESCRIPTION TABLE \*\*\*\*\*

***** COMMUNITY TYPE AND PLOT NUMBERS *****									
***** BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* *****									
***** SITE *****									
***** DESCRIPTORS *****									
***** plot key id number *****									
***** formation *****									
***** series (first ind app) *****									
***** habitat type (2nd app) *****									
***** dominant life form *****									
***** live life form size class *****									
***** live canopy cover class *****									
***** upper layer dom species *****									
***** upper layer dom species *****									
***** mid layer dom species 1 *****									
***** mid layer dom species 2 *****									
***** lower layer dom species *****									
***** lower layer dom species *****									
***** special features *****									
***** geomorphic landform *****									
***** surficial geology *****									
***** plot position *****									
***** slope shape (vertical) *****									
***** slope shape (horizontal) *****									
***** elevation (ft mal) *****									
***** aspect (azimuth) *****									
***** slope (Z) *****									
***** bare ground cover (Z) *****									
***** gravel ground cover (Z) *****									
***** rock ground cover (Z) *****									
***** litter ground cover (Z) *****									
***** woody ground cover (Z) *****									
***** bryophyte ground cov (Z) *****									
***** basal veg cover (Z) *****									
***** water cover (Z) *****									
***** fuel loading class-model *****									
***** duff-litter depth (in) *****									
***** live basal area (sqft/ac) *****									
***** live tree dbh (in) *****									
***** ave live tree height (ft) *****									
***** dominant tree age (yr) *****									
***** tree total cover (Z) *****									
***** tree seedling cover (Z) *****									
***** tree sapling cover (Z) *****									
***** tree pole cover (Z) *****									
***** tree medium cover (Z) *****									
***** tree large cover (Z) *****									
***** tree very large cover (Z) *****									
***** shrub total cover (Z) *****									
***** grass total cover (Z) *****									
***** forb total cover (Z) *****									
***** fern total cover (Z) *****									
***** bryophyte total cover (Z) *****									

\*\*\*\*\* SITE DESCRIPTION TABLE \*\*\*\*\*

\*\*\*\*\* COMMUNITY TYPE AND PLOT NUMBERS \*\*\*\*\*

SITE	BOTMO*	BOTMO*	BOTMO*	BOTMO*	BOTMO*	BOTPA*	BOTPA*	BOTPA*	BOTPE*	BOTPE*				
	N	N	N	N	N	R	R	R	D	D				
DESCRIPTORS	004	005	006	007	008	009	010	011	001	002	003	001	002	*
plot key id number	6JV010	6JV003	6JV007	6JV011	6JV006	5JV008	6JV016	6TS313	5JV008	6JV010	6JV016	6JV013	6JV006	
formation	CW	CF	SW	MS	H	M	LT	MT	THUPLI	TSUHET	CLIUNI	OPLHOR	OPLHOR	
series (first ind spp)	THUPLI	ALNSIN	THUPLI	ACREGLA	THUPLI	ABILAS	PICENG	X	OPHOR	THUPLI	THUPLI	THUPLI	THUPLI	
habitat type (2nd spp)	CLIUNI	ATHFIL	C	S	C	C	C	C	C	C	C	C	C	
dominant life form	live life form size class	live canopy cover class	upper layer dom species	upper layer dom species	POPRAE	ALNUS	ALNUS	1 TSUHET	mid layer dom species 1	THUPLI	SYMBL X	TAXBRE	ATHFIL	
live life form size class	live canopy cover class	upper layer dom species	upper layer dom species	POPRAE	ALNUS	ALNUS	1 TSUHET	mid layer dom species 1	THUPLI	SYMBL X	TAXBRE	ATHFIL	SMISTE X	
upper layer dom species	THUPLI	ACREGLA	THUPLI	ABILAS	PICENG	X	OPHOR	THUPLI	THUPLI	THUPLI	THUPLI	THUPLI	THUPLI	
upper layer dom species	POPRAE	ALNUS	ALNUS	1 TSUHET	mid layer dom species 1	THUPLI	SYMBL X	TAXBRE	ATHFIL	SMISTE X	VIOGIA	SENTRI X	SC BE	
mid layer dom species 1	THUPLI	ALNUS	ALNUS	1 TSUHET	mid layer dom species 1	THUPLI	SYMBL X	TAXBRE	ATHFIL	SMISTE X	VIOGIA	SENTRI X	SC BE	
lower layer dom species	CLIUNI	ATHFIL	C	S	C	C	C	C	C	C	C	C	C	
lower layer dom species	CLIUNI	ATHFIL	C	S	C	C	C	C	C	C	C	C	C	
special features	geomorphic landform	VA-SB	GM-MS	GT-	AL-SI	BE-X	BE-WI	BE-P	BE-S	BE-D	BE-D	BE-D	BE-D	
geomorphic landform	VA-SB	GM-MS	GT-	AL-SI	BE-X	BE-WI	BE-P	BE-S	BE-D	BE-D	BE-D	BE-D	BE-D	
surficial geology	VA-SB	GM-MS	GT-	AL-SI	BE-X	BE-WI	BE-P	BE-S	BE-D	BE-D	BE-D	BE-D	BE-D	
plot position	VA-SB	GM-MS	GT-	AL-SI	BE-X	BE-WI	BE-P	BE-S	BE-D	BE-D	BE-D	BE-D	BE-D	
slope shape (vertical)	VA-SB	GM-MS	GT-	AL-SI	BE-X	BE-WI	BE-P	BE-S	BE-D	BE-D	BE-D	BE-D	BE-D	
slope shape (horizontal)	VA-SB	GM-MS	GT-	AL-SI	BE-X	BE-WI	BE-P	BE-S	BE-D	BE-D	BE-D	BE-D	BE-D	
elevation (ft msl)	3760	4100	3840	3500	3200	4640	4200	3780	4640	3760	4200	3020	3200	
aspect (azimuthal)	0	180	220	0	0	180	280	47	180	0	280	0	0	
slope (%)	0	10	10	0	0	8	10	15	8	0	10	0	0	
bare ground cover (%)	0	1	0	0	0	1	1	10	1	0	1	0	0	
gravel ground cover (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	
rock ground cover (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	
litter ground cover (%)	80	20	10	80	80	40	70	60	40	80	70	90	80	
woody ground cover (%)	5	1	1	1	10	20	10	10	20	5	10	3	10	
bryophyte ground cov (%)	10	60	70	20	5	30	10	10	30	10	10	3	5	
basal veg cover (%)	5	10	3	3	3	10	3	10	10	5	5	3	3	
water cover (%)	0	3	10	1	0	5	3	0	5	0	3	0	0	
fuel loading class-model	8	6	5	8	8	4	8	6	4	8	8	8	8	
duff-litter depth (in)	12.00	12.00	6.00	6.00	2.00	30.00	12.00	2.00	30.00	12.00	12.00	1.00	2.00	
live basal area (sqft/ac)	240	80	0	240	280	280	160	200	280	240	160	400	280	
live tree dbh (in)	30	9	16	16	13	19	14	13	19	30	14	27	13	
ave live tree height (ft)	110	50	0	80	100	75	90	76	75	110	90	125	100	
dominant tree age (yr)	210	49	0	50	130	194	120	144	194	210	120	350	130	
tree total cover (%)	70	40	1	90	90	70	80	90	90	70	70	90	90	
tree seedling cover (%)	1	1	0	1	1	1	1	3	1	1	1	1	1	
tree sapling cover (%)	3	3	1	1	3	5	10	3	5	3	10	5	3	
tree pole cover (%)	10	30	0	10	10	5	20	0	5	10	20	10	10	
tree medium cover (%)	10	30	0	80	60	60	30	80	60	10	30	10	60	
tree large cover (%)	40	0	0	0	0	20	5	1	20	40	5	50	0	
tree very large cover (%)	5	0	0	0	10	0	0	0	0	5	0	10	10	
shrub total cover (%)	1	40	70	1	10	1	1	20	1	1	1	5	10	
grass total cover (%)	1	3	5	1	0	1	1	1	1	1	1	1	0	
forb total cover (%)	10	20	80	10	10	50	3	20	50	10	3	20	10	
fern total cover (%)	1	20	30	3	1	5	1	10	5	1	1	3	1	
bryophyte total cover (%)	10	60	70	20	5	30	10	10	30	10	10	3	5	



\*\*\*\*\* SYNTHESIS TABLE \*\*\*\*\*

[illegible][illegible]

*****	Trees	*****
ABIGRAVT	1	60
ABILASVT	--	--
BETPAVTV	--	10
LAROCOVTV	--	--
PICEA VT	5	3
PICENGVT	20	--
PINMONVT	1	--
POPALAVT	1	--
POPTREVT	--	--
PSEMENTVT	1	10
THUPLIVT	1	30
TSUHETVTV	--	--

[illegible]

[illegible][illegible][illegible]

EPIGLAVF FRAVESVF FRAVIRVF GALIUNVF GALTRVVF GALTRIVF GENAMAVF GEURIVVF GOOBLVVF HABDILVF HABSAVVF HERLANVF HIEALBVF LISBORVF LISCONVF LISTERVF LONGILVF MEDLUPVF MENARVVF MINGUTVF MITELVVF MITNUVVF MITSTAVF MOELATVF MONUNIVF OMSCEVVF OSMCHVVF OSMDPEVVF PARFIMVF PEDBSAVF PETBSAGVF PLAMAJVF POTANSVF POTGRAVF PRIVULVF PYRASAVF PYRCHLVF RANUNCVF SANMARVF SENPSEVF SENTRIVF SMILACVF SMIRACVF SMITSEVF SOLCANVF SOLIDAVF STEOCVVF STRAMPVF TAROFVVF THALICVF THAOCCVF TIAIRVVF TRACARVF TRIOVAVF TRIEPVF VALDIOVF

[illegible]

[illegible]

## \*\*\*\*\* SYNTHESIS TABLE \*\*\*\*\*

Species Abundance Value: canopy cover (%)

Minimum Species ID level used from PC Data Base (%): 0

		COMMUNITY TYPE AND PLOT NUMBERS																
		***** BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* BOTMI* *****																
Species	Codes	* N	* N	* N	* N	* N	* N	* N	* N	* N	* N	* N	* N	* N	* N	* N	* N	* N
*****		*****																
* 007 * 008 * 009 * 010 * 011 * 012 * 013 * 014 * 015 * 016 * 017 * 018 * 001 * 002 * 003 *		*****																
*****		*****																
***** trees *****		*****																
ABIGRAVT	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	3
ABILASVT	--	--	5	--	5	--	--	--	--	--	--	5	--	--	1	--	5	--
BETPAPVT	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LAROCVT	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PICEA VT	3	3	1	--	5	3	3	5	--	--	--	--	--	--	--	5	3	--
PICENGVT	--	--	--	--	5	--	--	--	--	--	--	--	--	10	--	--	--	--
PINMONVT	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
POPALVT	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--	--	--	--
POPTREVT	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PSEMENV	--	--	--	--	--	3	--	5	--	--	--	--	--	--	--	--	--	3
TRUPLIVT	70	10	80	80	60	70	50	90	50	60	60	50	90	60	90	60	70	3
TSUBETVT	3	--	--	--	1	10	10	--	--	--	--	30	--	--	3	1	10	--
***** shrubs *****		*****																
ACEGLAVS	1	--	1	--	1	--	--	1	--	--	--	--	1	--	--	1	--	--
ALNINCVS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ALNSINVS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ALNUS VS	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AMEALNVS	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
CORCANVS	--	--	1	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--
CORSTOVS	--	--	1	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--
LINBORVS	--	--	3	1	3	1	1	--	--	--	--	1	--	--	1	20	1	--
LONINVS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LONUTAVS	1	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
MAHEPVVS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MENPERVS	3	--	1	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--
OPLHORVS	20	20	3	1	--	1	--	3	--	--	--	--	3	--	1	--	1	--
PAXMYRVS	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PRUVIRVS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RHAALNVS	--	--	--	--	1	1	1	--	--	--	--	--	--	--	--	1	--	--
RIBLACVS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ROSA VS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ROSGYMVS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ROSMOOVS	--	--	--	--	1	--	1	--	--	--	--	1	--	--	--	1	--	--
RUBIDAVS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RUBPARVS	--	--	1	--	--	1	1	--	--	--	--	1	--	--	--	--	1	--
RUBPUBVS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SALIX VS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SAMRACVS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SORSCOVVS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPIBETVS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SYMALBVS	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	1	--	--
TAXBREVS	--	--	3	--	--	--	--	--	--	--	--	1	--	1	--	--	--	--



EPIGLAVF  
FRAVESVF  
FRAVRVF  
GALIUWVF  
GALTRFVF  
GALTRIVF  
GENAMVF  
GEUMACVF  
GEURIVVF  
GOOBLVF  
HABDILVF  
HABSACVF  
HERLANVF  
HIEALBVF  
LISBORVF  
LISBORVF  
LISCORVF  
LISTERVF  
LONGILVF  
MEDLUPVF  
MENARVF  
MIMTELVF  
MITELLVF  
MITNUDVF  
MITSTAVF  
MOELATVF  
MONUNIVF  
ORTSECVF  
OSMCHIVF  
OSMDEPVF  
PARFIMVF  
PEDBRAVF  
PETSAGVF  
PLAMAJVF  
POTANJVF  
POTGRAVF  
PRVULVF  
PYRASAVF  
PYRCHLVF  
RANUNCVF  
SANMARVF  
SENSEPVF  
SENTRIVF  
SMILACVF  
SMITACVF  
SMISTEIVF  
SOLCANVF  
SOLIDAVF  
STEOCCVF  
STRAMPVF  
TAROFFVF  
THALICVF  
THAOCVVF  
TIAIRCVF  
TRACARVF  
TRIOPAVF  
TIREPVF  
VALDIOVF

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title: KOOTENAI MOONWORTS

97/01/31

\*\*\*\* constancy (average abund) table \*\*\*\*  
\*\*\* [ minimum - maximum ] range \*\*\*

species abundance value: canopy cover (%)  
minimum species id level from pc data base (%): 0

strata type names									
species abbreviations	*BOTASC * n = 3	*BOTCRE * n = 6	*BOTMIN * n = 18	*BOTWON * n = 11	*BOTPAR * n = 3	*BOTPED * n = 2			
**** trees ****									
ABIGRAVT	33 ( 1 ) [ 1-1 ]	17 ( 1 ) [ 1-1 ]	11 ( 32 ) [ 3-60 ]	18 ( 2 ) [ 1-3 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
ABILASVT	0 ( 0 ) [ 0-0 ]	33 ( 2 ) [ 1-3 ]	22 ( 4 ) [ 1-5 ]	55 ( 6 ) [ 1-20 ]	33 ( 1 ) [ 1-1 ]	50 ( 5 ) [ 5-5 ]			
BETAPAVT	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	11 ( 15 ) [ 10-20 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
LAROCCTV	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	6 ( 2 ) [ 2-2 ]	18 ( 2 ) [ 1-2 ]	33 ( 2 ) [ 2-2 ]	0 ( 0 ) [ 0-0 ]			
PICRA VT	0 ( 0 ) [ 0-0 ]	50 ( 5 ) [ 5-5 ]	56 ( 3 ) [ 1-5 ]	46 ( 3 ) [ 1-5 ]	33 ( 3 ) [ 3-3 ]	100 ( 3 ) [ 1-5 ]			
PICENGVT	33 ( 20 ) [ 20-20 ]	50 ( 9 ) [ 3-20 ]	28 ( 7 ) [ 1-10 ]	36 ( 4 ) [ 1-10 ]	67 ( 3 ) [ 1-5 ]	0 ( 0 ) [ 0-0 ]			
PINKONVT	33 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	9 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
POPRALVT	0 ( 0 ) [ 0-0 ]	33 ( 6 ) [ 1-10 ]	17 ( 14 ) [ 1-30 ]	9 ( 10 ) [ 10-10 ]	33 ( 10 ) [ 10-10 ]	0 ( 0 ) [ 0-0 ]			
POPTREVT	0 ( 0 ) [ 0-0 ]	17 ( 20 ) [ 20-20 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
PSEMENTVT	33 ( 1 ) [ 1-1 ]	33 ( 2 ) [ 1-3 ]	28 ( 6 ) [ 1-10 ]	18 ( 3 ) [ 3-3 ]	33 ( 3 ) [ 3-3 ]	50 ( 5 ) [ 5-5 ]			
THUPLIVT	33 ( 1 ) [ 1-1 ]	33 ( 43 ) [ 5-80 ]	83 ( 57 ) [ 1-90 ]	91 ( 65 ) [ 40-90 ]	100 ( 67 ) [ 50-80 ]	100 ( 85 ) [ 80-90 ]			
TSUBETVT	0 ( 0 ) [ 0-0 ]	33 ( 1 ) [ 1-1 ]	39 ( 11 ) [ 1-30 ]	55 ( 10 ) [ 1-30 ]	67 ( 7 ) [ 3-10 ]	0 ( 0 ) [ 0-0 ]			
**** shrubs ****									
ACEGLAVS	33 ( 10 ) [ 10-10 ]	50 ( 11 ) [ 3-20 ]	39 ( 4 ) [ 1-20 ]	46 ( 3 ) [ 1-10 ]	33 ( 1 ) [ 1-1 ]	100 ( 1 ) [ 1-1 ]			
ALNINCVS	33 ( 10 ) [ 10-10 ]	33 ( 15 ) [ 10-20 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
ALNSINVS	67 ( 43 ) [ 5-80 ]	33 ( 25 ) [ 10-40 ]	17 ( 34 ) [ 3-80 ]	9 ( 5 ) [ 5-5 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
ALNUS VS	0 ( 0 ) [ 0-0 ]	17 ( 50 ) [ 50-50 ]	11 ( 17 ) [ 3-30 ]	9 ( 30 ) [ 30-30 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
AMEALNVS	33 ( 1 ) [ 1-1 ]	17 ( 1 ) [ 1-1 ]	17 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
CORCANVS	67 ( 6 ) [ 1-10 ]	83 ( 5 ) [ 1-10 ]	28 ( 1 ) [ 1-1 ]	27 ( 1 ) [ 1-1 ]	33 ( 1 ) [ 1-1 ]	50 ( 1 ) [ 1-1 ]			
CORSTOVVS	67 ( 20 ) [ 20-20 ]	67 ( 9 ) [ 3-20 ]	28 ( 6 ) [ 1-20 ]	27 ( 7 ) [ 1-20 ]	0 ( 0 ) [ 0-0 ]	50 ( 1 ) [ 1-1 ]			
LINBORVS	67 ( 6 ) [ 1-10 ]	50 ( 4 ) [ 1-10 ]	67 ( 3 ) [ 1-20 ]	82 ( 4 ) [ 1-20 ]	100 ( 2 ) [ 1-3 ]	50 ( 3 ) [ 3-3 ]			
LONINVS	33 ( 1 ) [ 1-1 ]	33 ( 1 ) [ 1-1 ]	6 ( 1 ) [ 1-1 ]	9 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
LONUTAVS	33 ( 1 ) [ 1-1 ]	33 ( 1 ) [ 1-1 ]	17 ( 1 ) [ 1-1 ]	9 ( 1 ) [ 1-1 ]	33 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]			
MAHREPVS	33 ( 1 ) [ 1-1 ]	50 ( 1 ) [ 1-1 ]	11 ( 1 ) [ 1-1 ]	9 ( 1 ) [ 1-1 ]	33 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]			
MENFERVS	0 ( 0 ) [ 0-0 ]	17 ( 1 ) [ 1-1 ]	22 ( 1 ) [ 1-3 ]	27 ( 2 ) [ 1-3 ]	0 ( 0 ) [ 0-0 ]	50 ( 1 ) [ 1-1 ]			
OPHFORVS	0 ( 0 ) [ 0-0 ]	17 ( 1 ) [ 1-1 ]	44 ( 7 ) [ 1-20 ]	36 ( 2 ) [ 1-3 ]	0 ( 0 ) [ 0-0 ]	100 ( 3 ) [ 3-3 ]			
PAXMYRVS	0 ( 0 ) [ 0-0 ]	17 ( 1 ) [ 1-1 ]	11 ( 2 ) [ 1-3 ]	27 ( 2 ) [ 1-3 ]	33 ( 1 ) [ 1-1 ]	50 ( 3 ) [ 3-3 ]			
PRUVIRVS	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	6 ( 3 ) [ 3-3 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
RHAALNVS	67 ( 6 ) [ 1-10 ]	67 ( 21 ) [ 1-70 ]	22 ( 1 ) [ 1-1 ]	18 ( 1 ) [ 1-1 ]	33 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]			
RIBLACVS	33 ( 1 ) [ 1-1 ]	83 ( 1 ) [ 1-3 ]	28 ( 1 ) [ 1-1 ]	46 ( 1 ) [ 1-1 ]	100 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]			
ROSA VS	33 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]	6 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
ROSGYMVS	0 ( 0 ) [ 0-0 ]	17 ( 3 ) [ 3-3 ]	6 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
ROSWOOVS	67 ( 1 ) [ 1-1 ]	67 ( 1 ) [ 1-1 ]	28 ( 1 ) [ 1-1 ]	55 ( 1 ) [ 1-1 ]	67 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]			
RUBIDAVS	100 ( 1 ) [ 1-1 ]	50 ( 2 ) [ 1-3 ]	11 ( 1 ) [ 1-1 ]	9 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
RUBPARVS	67 ( 6 ) [ 1-10 ]	50 ( 1 ) [ 1-1 ]	39 ( 2 ) [ 1-10 ]	55 ( 3 ) [ 1-10 ]	33 ( 1 ) [ 1-1 ]	50 ( 1 ) [ 1-1 ]			
RUBPUBVS	33 ( 1 ) [ 1-1 ]	33 ( 6 ) [ 1-10 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
SALIX VS	0 ( 0 ) [ 0-0 ]	17 ( 1 ) [ 1-1 ]	6 ( 3 ) [ 3-3 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
SAMRACVS	0 ( 0 ) [ 0-0 ]	33 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
SORSCOVVS	0 ( 0 ) [ 0-0 ]	17 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
SPIBETVS	67 ( 1 ) [ 1-1 ]	17 ( 1 ) [ 1-1 ]	6 ( 1 ) [ 1-1 ]	27 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]	0 ( 0 ) [ 0-0 ]			
SYMALBVS	100 ( 11 ) [ 3-20 ]	83 ( 5 ) [ 1-20 ]	44 ( 11 ) [ 1-50 ]	46 ( 5 ) [ 1-20 ]	33 ( 1 ) [ 1-1 ]	0 ( 0 ) [ 0-0 ]			

TAXBREVS	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 3 ) [ 3 - 3 ]	9 ( 3 ) [ 3 - 3 ]	0 ( 0 ) [ 0 - 0 ]	33 ( 1 ) [ 1 - 1 ]	50 ( 3 ) [ 3 - 3 ]
VACMEMVS	0 ( 0 ) [ 0 - 0 ]	17 ( 1 ) [ 1 - 1 ]	22 ( 2 ) [ 1 - 5 ]	36 ( 3 ) [ 1 - 10 ]	33 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
VACMYRVS	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	11 ( 1 ) [ 1 - 1 ]	36 ( 1 ) [ 1 - 1 ]	67 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
VACSCOV5	0 ( 0 ) [ 0 - 0 ]	17 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]

\*\*\*\*\* grasses

AGRSICAVG	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 3 ) [ 3 - 3 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
AGRSICAVG	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 60 ) [ 60 - 60 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
BROWULVG	33 ( 1 ) [ 1 - 1 ]	17 ( 1 ) [ 1 - 1 ]	22 ( 1 ) [ 1 - 1 ]	36 ( 1 ) [ 1 - 1 ]	33 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CALCANVG	0 ( 0 ) [ 0 - 0 ]	17 ( 5 ) [ 5 - 5 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CARAUVRG	0 ( 0 ) [ 0 - 0 ]	17 ( 1 ) [ 1 - 1 ]	6 ( 3 ) [ 3 - 3 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CARDEWVG	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 1 ) [ 1 - 1 ]	9 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CARDISVG	33 ( 1 ) [ 1 - 1 ]	17 ( 1 ) [ 1 - 1 ]	11 ( 2 ) [ 1 - 3 ]	27 ( 2 ) [ 1 - 3 ]	33 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CAREX VG	0 ( 0 ) [ 0 - 0 ]	33 ( 1 ) [ 1 - 1 ]	6 ( 1 ) [ 1 - 1 ]	9 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CARMICVG	0 ( 0 ) [ 0 - 0 ]	17 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CARUTRVG	0 ( 0 ) [ 0 - 0 ]	33 ( 2 ) [ 1 - 3 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CINLATVG	0 ( 0 ) [ 0 - 0 ]	17 ( 1 ) [ 1 - 1 ]	6 ( 1 ) [ 1 - 1 ]	18 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
DESELOVG	0 ( 0 ) [ 0 - 0 ]	33 ( 3 ) [ 1 - 5 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
ELYGLAVG	100 ( 1 ) [ 1 - 1 ]	50 ( 2 ) [ 1 - 3 ]	6 ( 1 ) [ 1 - 1 ]	18 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
FESOCVVG	0 ( 0 ) [ 0 - 0 ]	17 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
GLYGRAVG	67 ( 1 ) [ 1 - 1 ]	17 ( 1 ) [ 1 - 1 ]	6 ( 1 ) [ 1 - 1 ]	9 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
GLYSTRVG	67 ( 1 ) [ 1 - 1 ]	17 ( 1 ) [ 1 - 1 ]	17 ( 4 ) [ 1 - 10 ]	18 ( 6 ) [ 1 - 10 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
GRASS VG	0 ( 0 ) [ 0 - 0 ]	33 ( 2 ) [ 1 - 3 ]	17 ( 1 ) [ 1 - 1 ]	27 ( 1 ) [ 1 - 1 ]	33 ( 1 ) [ 1 - 1 ]	50 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]
HORJUBVG	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
JUNBALVG	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
ORYASPVG	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 1 ) [ 1 - 1 ]	9 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
PHAARUVG	0 ( 0 ) [ 0 - 0 ]	17 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
POAPRAVG	0 ( 0 ) [ 0 - 0 ]	17 ( 5 ) [ 5 - 5 ]	6 ( 10 ) [ 10 - 10 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
TRICERVG	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	11 ( 1 ) [ 1 - 1 ]	9 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	50 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]

\*\*\*\*\* forbs

ACOCOLVF	67 ( 1 ) [ 1 - 1 ]	33 ( 7 ) [ 3 - 10 ]	17 ( 1 ) [ 1 - 1 ]	18 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	50 ( 1 ) [ 1 - 1 ]
ACTRUBVF	67 ( 1 ) [ 1 - 1 ]	67 ( 2 ) [ 1 - 3 ]	56 ( 1 ) [ 1 - 1 ]	73 ( 1 ) [ 1 - 1 ]	100 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]
ADEBICVF	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	33 ( 1 ) [ 1 - 1 ]	36 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	50 ( 1 ) [ 1 - 1 ]
ANAMARVF	0 ( 0 ) [ 0 - 0 ]	17 ( 1 ) [ 1 - 1 ]	6 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
ANEMULVF	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 3 ) [ 3 - 3 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
ANGARGVF	67 ( 1 ) [ 1 - 1 ]	50 ( 1 ) [ 1 - 1 ]	11 ( 1 ) [ 1 - 1 ]	9 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
ANTHICVF	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 30 ) [ 30 - 30 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
ARANUDVF	100 ( 2 ) [ 1 - 3 ]	67 ( 2 ) [ 1 - 3 ]	39 ( 1 ) [ 1 - 3 ]	27 ( 1 ) [ 1 - 1 ]	33 ( 1 ) [ 1 - 1 ]	100 ( 1 ) [ 1 - 1 ]
ARNCORVF	0 ( 0 ) [ 0 - 0 ]	17 ( 1 ) [ 1 - 1 ]	22 ( 1 ) [ 1 - 1 ]	46 ( 1 ) [ 1 - 1 ]	67 ( 1 ) [ 1 - 1 ]	50 ( 1 ) [ 1 - 1 ]
ARNLATVF	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 1 ) [ 1 - 1 ]	9 ( 10 ) [ 10 - 10 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
ASACAUVF	0 ( 0 ) [ 0 - 0 ]	17 ( 1 ) [ 1 - 1 ]	6 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
ASTER VF	0 ( 0 ) [ 0 - 0 ]	17 ( 1 ) [ 1 - 1 ]	11 ( 1 ) [ 1 - 1 ]	9 ( 1 ) [ 1 - 1 ]	33 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]
ASTFOLVF	0 ( 0 ) [ 0 - 0 ]	17 ( 10 ) [ 10 - 10 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CERFONVF	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CHLUMBVF	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	28 ( 1 ) [ 1 - 1 ]	55 ( 1 ) [ 1 - 1 ]	100 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]
CIRALPVF	67 ( 2 ) [ 1 - 3 ]	0 ( 0 ) [ 0 - 0 ]	22 ( 2 ) [ 1 - 3 ]	18 ( 2 ) [ 1 - 3 ]	0 ( 0 ) [ 0 - 0 ]	50 ( 3 ) [ 3 - 3 ]
CIRARVF	67 ( 2 ) [ 1 - 3 ]	33 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	9 ( 3 ) [ 3 - 3 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CIRSIUVF	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CIRVULVF	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CLIUNIVF	33 ( 1 ) [ 1 - 1 ]	67 ( 1 ) [ 1 - 1 ]	78 ( 3 ) [ 1 - 10 ]	91 ( 3 ) [ 1 - 10 ]	100 ( 5 ) [ 1 - 10 ]	0 ( 0 ) [ 0 - 0 ]
CONCANVF	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
COPOCCVF	33 ( 1 ) [ 1 - 1 ]	17 ( 1 ) [ 1 - 1 ]	22 ( 1 ) [ 1 - 1 ]	18 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
CORTIVF	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	11 ( 1 ) [ 1 - 1 ]	9 ( 1 ) [ 1 - 1 ]	33 ( 1 ) [ 1 - 1 ]	50 ( 1 ) [ 1 - 1 ]
CYNOFFVF	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
DISHOOVF	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 1 ) [ 1 - 1 ]	18 ( 1 ) [ 1 - 1 ]	33 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]
DISTRADF	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	6 ( 1 ) [ 1 - 1 ]	9 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]
DODPULVF	33 ( 1 ) [ 1 - 1 ]	17 ( 1 ) [ 1 - 1 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]	0 ( 0 ) [ 0 - 0 ]

EPICILVF	33	(1)	1-1	33	(2)	1-3	6	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
EPICLAVF	0	(0)	0-0	0	(0)	0-0	6	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
FRAVESVF	33	(1)	1-1	33	(1)	1-1	11	(1)	1-1	9	(1)	1-1	0	(0)	0-0	50	(1)	1-1
FRVIRVF	100	(1)	1-1	33	(1)	1-1	6	(1)	1-1	9	(1)	1-1	0	(0)	0-0	0	(0)	0-0
GALIUMVF	33	(1)	1-1	17	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
GALTRFVF	0	(0)	0-0	17	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	100	(1)	1-1
GALTRIVF	67	(2)	1-3	83	(3)	1-5	72	(1)	1-3	73	(1)	1-1	100	(1)	1-1	0	(0)	0-0
GENAMVF	0	(0)	0-0	17	(1)	1-1	6	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
GEUMACVF	100	(1)	1-1	50	(1)	1-1	11	(1)	1-1	9	(1)	1-1	0	(0)	0-0	0	(0)	0-0
GEURIVVF	0	(0)	0-0	17	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	100	(1)	1-1
GOOBLVF	0	(0)	0-0	0	(0)	0-0	50	(1)	1-1	64	(1)	1-1	67	(1)	1-1	0	(0)	0-0
HABDILVF	33	(1)	1-1	33	(1)	1-1	0	(0)	0-0	9	(1)	1-1	0	(0)	0-0	0	(0)	0-0
HABSACVF	0	(0)	0-0	17	(1)	1-1	28	(1)	1-1	27	(1)	1-1	33	(1)	1-1	0	(0)	0-0
HERLANVF	0	(0)	0-0	0	(0)	0-0	6	(1)	1-1	9	(1)	1-1	0	(0)	0-0	0	(0)	0-0
HIEALBVF	0	(0)	0-0	0	(0)	0-0	11	(1)	1-1	27	(1)	1-1	67	(1)	1-1	0	(0)	0-0
LISBORVF	0	(0)	0-0	17	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
LISCONVF	33	(1)	1-1	0	(0)	0-0	0	(0)	0-0	9	(1)	1-1	0	(0)	0-0	0	(0)	0-0
LISCORVF	0	(0)	0-0	0	(0)	0-0	28	(1)	1-1	27	(1)	1-1	0	(0)	0-0	0	(0)	0-0
LISTERVF	0	(0)	0-0	17	(1)	1-1	11	(1)	1-1	18	(1)	1-1	33	(1)	1-1	0	(0)	0-0
LONCILVF	0	(0)	0-0	0	(0)	0-0	6	(1)	1-1	9	(1)	1-1	0	(0)	0-0	0	(0)	0-0
MEDLUPVF	0	(0)	0-0	0	(0)	0-0	6	(20)	20-20	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
MENARVF	67	(1)	1-1	0	(0)	0-0	11	(1)	1-1	9	(1)	1-1	0	(0)	0-0	0	(0)	0-0
MIMGUTVF	33	(1)	1-1	0	(0)	0-0	6	(1)	1-1	9	(1)	1-1	0	(0)	0-0	0	(0)	0-0
MITELLVF	33	(1)	1-1	0	(0)	0-0	6	(1)	1-1	9	(1)	1-1	33	(1)	1-1	0	(0)	0-0
MITNUDF	33	(1)	1-1	67	(3)	1-10	11	(1)	1-1	18	(1)	1-1	33	(1)	1-1	0	(0)	0-0
MITTAVF	0	(0)	0-0	17	(3)	3-3	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
MOELATVF	0	(0)	0-0	0	(0)	0-0	6	(3)	3-3	46	(1)	1-1	0	(0)	0-0	0	(0)	0-0
MONUNIVF	0	(0)	0-0	17	(1)	1-1	22	(1)	1-1	0	(0)	0-0	67	(1)	1-1	0	(0)	0-0
ORTSECVF	33	(1)	1-1	0	(0)	0-0	56	(1)	1-1	82	(1)	1-1	100	(1)	1-1	50	(1)	1-1
OSMCHIVF	33	(1)	1-1	17	(1)	1-1	44	(1)	1-1	36	(1)	1-1	67	(1)	1-1	50	(1)	1-1
OSMDEPVF	33	(1)	1-1	50	(1)	1-1	11	(1)	1-1	27	(1)	1-1	33	(1)	1-1	0	(0)	0-0
PARFIMVF	0	(0)	0-0	17	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
PEDBRAVF	0	(0)	0-0	17	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
PETSAGVF	0	(0)	0-0	17	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
PLAMAJVF	0	(0)	0-0	17	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
POTANSVF	0	(0)	0-0	0	(0)	0-0	6	(3)	3-3	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
POTGRAVF	0	(0)	0-0	0	(0)	0-0	6	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
PRUVULVF	67	(1)	1-1	17	(1)	1-1	11	(1)	1-1	9	(1)	1-1	0	(0)	0-0	0	(0)	0-0
PYRASAVF	33	(3)	1-3	67	(1)	1-1	33	(3)	1-10	46	(1)	1-3	33	(1)	1-1	0	(0)	0-0
PYRCHLVF	0	(0)	0-0	17	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
RANUNCVF	33	(1)	1-1	17	(1)	1-1	17	(1)	1-1	36	(1)	1-1	0	(0)	0-0	0	(0)	0-0
SANMARVF	0	(0)	0-0	17	(1)	1-1	6	(1)	1-1	9	(1)	1-1	0	(0)	0-0	0	(0)	0-0
SENSEVF	33	(1)	1-1	17	(1)	1-1	6	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
SENTRIVF	33	(3)	3-3	17	(1)	1-1	22	(1)	1-1	18	(2)	1-3	0	(0)	0-0	0	(0)	0-0
SMILACVF	0	(0)	0-0	17	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
SMIRACVF	0	(0)	0-0	17	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
SMISTEVF	100	(4)	1-5	83	(4)	1-10	72	(4)	1-20	82	(3)	1-10	67	(1)	1-1	100	(1)	1-1
SOLCANVF	0	(0)	0-0	0	(0)	0-0	6	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
SOLIDAVF	0	(0)	0-0	17	(10)	10-10	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
STEOCCVF	0	(0)	0-0	17	(1)	1-1	6	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
STRAMPVF	0	(0)	0-0	17	(3)	1-1	56	(1)	1-1	64	(1)	1-1	100	(1)	1-1	0	(0)	0-0
TAROFFVF	33	(1)	1-1	17	(1)	1-1	11	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
THALICVF	0	(0)	0-0	0	(0)	0-0	6	(1)	1-1	9	(1)	1-1	0	(0)	0-0	0	(0)	0-0
THAOCVF	67	(1)	1-1	50	(2)	1-3	22	(1)	1-1	36	(1)	1-1	0	(0)	0-0	0	(0)	0-0
TIATRIVF	0	(0)	0-0	17	(1)	1-1	61	(4)	1-20	64	(5)	1-20	33	(20)	20-20	100	(3)	3-3
TRACARVF	0	(0)	0-0	0	(0)	0-0	6	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0
TRIOAVF	67	(1)	1-1	50	(1)	1-1	67	(1)	1-1	82	(1)	1-1	100	(1)	1-1	50	(1)	1-1
TRIREFVF	0	(0)	0-0	17	(1)	1-1	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0	0	(0)	0-0

[illegible]



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\*\*\*\*\* AVERAGES OF SITE VARIABLES TABLE \*\*\*\*\*  
 \*\*\*\*\* Standard Deviations in Parenthesis \*\*\*\*\*

COMMUNITY TYPE NAMES										
Site Variables	*BOTASC	*BOTCRE	*BOTMIN	*BOTMID	*BOTPAR	*BOTPED	*BOTPED	*BOTPED	*BOTPED	*BOTPED
	N = 3	N = 6	N = 18	N = 11	N = 3	N = 2	N = 2	N = 2	N = 2	N = 2
elevation (ft msl)	3566.7( 303.5)	3811.7( 459.4)	3782.8( 627.2)	3987.3( 451.3)	4200.0( 440.0)	3110.0( 127.3)				
aspect (azimuths)	133.3( 117.2)	.0( .0)	116.8( 117.4)	124.3( 118.1)	153.3( 141.9)	.0( .0)				
slope (%)	6.7( 5.8)	1.2( 2.9)	8.3( 9.8)	6.9( 6.2)	6.0( 5.3)	.0( .0)				
bare ground cover (	.7( .6)	2.0( 3.9)	2.0( 7.0)	1.2( 3.0)	.7( .6)	.0( .0)				
gravel ground cover (	20.0( 34.6)	.0( .0)	3.5( 14.1)	.1( .3)	.0( .0)	.0( .0)				
rock ground cover (	.3( .6)	.5( 1.2)	.1( .3)	.4( .9)	.3( .6)	.0( .0)				
litter ground cover (	7.0( 5.2)	30.2( 25.8)	66.7( 26.0)	60.0( 26.8)	63.3( 20.8)	85.0( 7.1)				
woody ground cover (	1.0( .0)	4.5( 3.1)	6.1( 6.1)	6.7( 5.9)	11.7( 7.6)	6.5( 4.9)				
bryophyte ground co	51.0( 41.9)	42.2( 27.0)	13.2( 16.5)	23.5( 23.7)	16.7( 11.5)	4.0( 1.4)				
basal veg cover (%)	3.0( .0)	10.5( 5.4)	6.6( 4.7)	5.3( 3.1)	6.0( 3.6)	4.0( 1.4)				
water cover (%)	13.3( 15.3)	5.0( 7.7)	2.6( 7.0)	2.2( 3.1)	2.7( 2.5)	.0( .0)				
duff-litter depth (	3.3( 3.1)	5.5( 3.6)	8.5( 7.7)	9.9( 8.0)	18.0( 10.4)	1.5( .7)				
dominant layer ave	36.7( 28.9)	60.5( 42.5)	77.2( 40.7)	73.6( 29.0)	91.7( 17.6)	112.5( 17.7)				
live basal area(sqf	46.7( 80.8)	96.7( 71.2)	255.9( 147.9)	225.5( 116.3)	226.7( 61.1)	340.0( 84.9)				
live tree dbh (in)	4.0( 6.9)	13.3( 11.6)	18.5( 10.2)	15.8( 7.7)	21.0( 8.2)	20.0( 9.9)				
ave live tree heigh	26.7( 46.2)	69.2( 39.0)	83.2( 40.3)	73.7( 32.9)	91.7( 17.6)	112.5( 17.7)				
dominant tree age (	24.7( 42.7)	68.7( 43.3)	167.4( 154.4)	117.0( 62.4)	174.7( 48.0)	240.0( 155.6)				
tree total cover (%)	7.0( 11.3)	25.5( 28.3)	64.5( 32.1)	71.0( 27.8)	76.7( 11.5)	90.0( .0)				
tree seedling cover	.0( .0)	1.3( 1.4)	.8( .4)	1.0( .8)	1.0( .0)	1.0( .0)				
tree sapling cover	1.3( 1.5)	5.0( 7.6)	3.4( 4.5)	3.5( 2.6)	6.0( 3.6)	4.0( 1.4)				
tree pole cover (%)	.0( .0)	3.0( 4.0)	7.2( 7.8)	7.5( 7.3)	11.7( 7.6)	10.0( .0)				
tree medium cover (	3.3( 5.8)	8.3( 16.0)	30.6( 26.5)	44.5( 27.7)	33.3( 25.2)	35.0( 35.4)				
tree large cover (%)	.3( .6)	5.2( 12.2)	18.9( 17.1)	13.3( 15.1)	21.7( 17.6)	25.0( 35.4)				
tree very large cov	.0( .0)	.8( 2.0)	5.5( 9.5)	1.9( 3.2)	1.7( 2.9)	10.0( .0)				
shrub total cover (	56.7( 32.1)	50.0( 31.0)	20.7( 26.0)	15.0( 22.2)	1.0( .0)	7.5( 3.5)				
low shrub cover (%)	7.0( 5.2)	10.7( 10.3)	5.9( 9.9)	3.9( 6.0)	1.0( .0)	4.0( 1.4)				
shrub mid cover (%)	30.0( 20.0)	28.0( 27.3)	10.4( 14.7)	8.8( 16.3)	.3( .6)	2.5( 3.5)				
shrub tall cover (%)	30.0( 26.5)	15.0( 5.5)	6.4( 15.2)	2.5( 6.0)	.0( .0)	.5( .7)				
gram. total cover (	3.7( 2.3)	5.2( 7.4)	6.5( 17.3)	1.4( 1.4)	1.0( .0)	.5( .7)				
forb total cover (%)	40.0( 34.6)	41.7( 24.0)	14.6( 11.5)	19.6( 24.1)	21.0( 25.4)	15.0( 7.1)				
fern total cover (%)	12.0( 15.7)	4.7( 7.6)	8.0( 8.2)	8.6( 10.1)	2.3( 2.3)	2.0( 1.4)				
bryophyte total cov	51.0( 41.9)	40.5( 28.2)	13.2( 16.5)	23.5( 23.7)	16.7( 11.5)	4.0( 1.4)				

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\*\*\*\*\* SITE CATEGORICAL VARIABLE CONSTANCY TABLE \*\*\*\*\*  
 \*\*\*\*\* In Descending Order of Constancy \*\*\*\*\*  
 \*\*\*\*\* Constancy of Codes in Parentheses \*\*\*\*\*

COMMUNITY TYPE NAMES											
Site Categorical Variables	*BOTASC * N = 3	*BOTCRE * N = 6	*BOTMIN * N = 18	*BOTMON * N = 11	*BOTPAR * N = 3	*BOTPED * N = 2					
vegetation formation	( 67) SW ( 33) CW ( 0) ( 0) ( 0)	( 67) CW ( 17) SW ( 17) CF ( 0) ( 0)	( 50) CW ( 33) CF ( 11) HW ( 6) SW ( 0)	( 45) CF ( 45) CW ( 9) SW ( 0) ( 0)	( 67) CW ( 33) CF ( 0) ( 0) ( 0)	(100) CW ( 0) ( 0) ( 0) ( 0)					
pvc indicator species 1	( 67) ALNSIN ( 33) PICEA ( 0) ( 0) ( 0)	( 50) PICEA ( 33) THUPLI ( 17) ALNSIN ( 0) ( 0)	( 61) THUPLI ( 22) TSUHET ( 6) PICENG ( 6) ALNSIN ( 6) AGRSTO	( 55) THUPLI ( 36) TSUHET ( 9) ALNSIN ( 0) ( 0)	( 67) TSUHET ( 33) THUPLI ( 0) ( 0) ( 0)	(100) THUPLI ( 0) ( 0) ( 0) ( 0)					
pvc indicator species 2	( 33) CORSTO ( 0) ( 0) ( 0) ( 0)	( 33) CORSTO ( 17) CLIUNI ( 17) EQUARV ( 17) OPLHOR ( 0)	( 44) CLIUNI ( 33) OPLHOR ( 6) ATHFIL ( 6) CORSTO ( 0)	( 64) CLIUNI ( 18) OPLHOR ( 9) ATHFIL ( 0) ( 0)	(100) CLIUNI ( 0) ( 0) ( 0) ( 0)	(100) OPLHOR ( 0) ( 0) ( 0) ( 0)					
pvc indicator species 3	( 0) ( 0) ( 0) ( 0) ( 0)	( 17) CLIUNI ( 0) ( 0) ( 0) ( 0)	( 17) ARANUD ( 6) ARANUDP ( 6) ATHFIL ( 0) ( 0)	( 9) ARANUDP ( 9) ATHFIL ( 9) CLIUNI ( 9) ARANUD ( 0)	( 33) ATHFIL ( 33) CLIUNI ( 0) ( 0) ( 0)	( 0) ( 0) ( 0) ( 0) ( 0)					
pvc site phase	( 0) ( 0) ( 0) ( 0) ( 0)	( 0) ( 0) ( 0) ( 0) ( 0)	( 11) ARANUD ( 0) ( 0) ( 0) ( 0)	( 18) ARANUD ( 0) ( 0) ( 0) ( 0)	( 33) ARANUD ( 0) ( 0) ( 0) ( 0)	( 0) ( 0) ( 0) ( 0) ( 0)					
dominant life form	( 67) S ( 33) C ( 0) ( 0) ( 0)	( 50) S ( 33) C ( 17) B ( 0) ( 0)	( 78) C ( 11) S ( 6) B ( 6) H ( 0)	( 91) C ( 9) S ( 0) ( 0) ( 0)	(100) C ( 0) ( 0) ( 0) ( 0)	(100) C ( 0) ( 0) ( 0) ( 0)					
live life form size class	( 33) MT ( 33) TS ( 33) MS ( 0)	( 50) MT ( 33) TS ( 17) MS ( 0)	( 39) MT ( 33) LT ( 11) VL ( 6) TS	( 73) MT ( 18) LT ( 9) MS ( 0)	( 67) MT ( 33) LT ( 0) ( 0)	( 50) LT ( 50) MT ( 0) ( 0)					

dead life form size class	( 0)	( 0)	( 6) MS	( 0)	( 0)	( 0)	( 0)
( 33) N	( 33) N	( 33) TS	( 28) MT	( 27) MT	( 33) MT	( 50) LT	( 50) PT
( 33) TS	( 33) TS	( 17) PT	( 17) PT	( 18) PT	( 33) SA	( 0)	( 0)
( 33) MS	( 33) MT	( 0)	( 11) SA	( 18) SA	( 0)	( 0)	( 0)
( 0)	( 0)	( 0)	( 11) N	( 9) MS	( 0)	( 0)	( 0)
( 0)	( 0)	( 0)	( 0)	( 0)	( 0)	( 0)	( 0)
live life form cover c/s	( 50) H	( 33) L	( 83) H	( 82) H	( 67) H	( 100) H	
( 67) H	( 33) L	( 17) M	( 17) M	( 18) M	( 33) M	( 0)	
( 33) L	( 0)	( 0)	( 0)	( 0)	( 0)	( 0)	
( 0)	( 0)	( 0)	( 0)	( 0)	( 0)	( 0)	
( 0)	( 0)	( 0)	( 0)	( 0)	( 0)	( 0)	
upper layer dominant spp	( 33) ALNSIN	( 33) ACEGLA	( 78) THUPLI	( 91) THUPLI	( 100) THUPLI	( 100) THUPLI	
( 67) ALNSIN	( 33) NP	( 33) PICEA	( 39) X	( 18) PICENG	( 33) PICENG	( 50) X	
( 33) NP	( 33) PICEA	( 33) THUPLI	( 17) PICENG	( 18) ABILAS	( 33) POPEAL	( 50) ABILAS	
( 33) PICEA	( 33) X	( 17) CORSTO	( 11) TSUHET	( 9) ABIGRA	( 33) X	( 0)	
( 33) X	( 33) ACEGLA	( 17) CORSTO	( 11) ABIGRA	( 9) POPEAL	( 0)	( 0)	
( 33) ACEGLA							
middle layer dominant spp	( 50) RHAALN	( 33) ALNINC	( 72) X	( 64) X	( 67) THUPLI	( 50) THUPLI	
( 67) CORSTO	( 33) ALNINC	( 33) CORSTO	( 39) THUPLI	( 45) THUPLI	( 67) TSUHET	( 50) X	
( 33) ALNINC	( 33) RHAALN	( 33) SOLIDA	( 22) OPLHOR	( 18) TSUHET	( 33) ATHFIL	( 50) OPLHOR	
( 33) RHAALN	( 33) X	( 17) ALNUS	( 17) NP	( 9) ALNUS	( 33) X	( 50) TAXBRE	
( 33) X	( 17) SOLIDA	( 17) ALNUS	( 11) ALNUS	( 9) CORSTO	( 0)	( 0)	
( 33) SYMALB							
lower layer dominant spp	( 67) SMISTE	( 33) CORCAN	( 33) SMISTE	( 64) X	( 100) X	( 100) CLIUNI	
( 67) SMISTE	( 33) EQUARV	( 33) LINBOR	( 33) X	( 36) TIATRI	( 67) CLIUNI	( 50) OPLHOR	
( 33) CORCAN	( 33) LINBOR	( 17) SENTRI	( 28) CLIUNI	( 27) CLIUNI	( 33) TIATRI	( 50) TIATRI	
( 33) EQUARV	( 33) SENTRI		( 22) TIATRI	( 18) ATHFIL	( 0)	( 0)	
( 33) LINBOR			( 17) SMISTE	( 9) LINBOR	( 0)	( 0)	
( 33) SENTRI							
special features	( 67) SC	( 33) SA	( 56) SC	( 45) SC	( 100) SC	( 100) SC	
( 67) SC	( 33) SA	( 33) SC	( 22) BE	( 36) BE	( 0)	( 0)	
( 33) SA	( 0)	( 17) MS	( 6) NS	( 9) SA	( 0)	( 0)	
( 0)	( 0)	( 0)	( 6) SA	( 9) N	( 0)	( 0)	
( 0)	( 0)	( 0)	( 6) N	( 0)	( 0)	( 0)	
geomorphic landform	( 100) VA-SB	( 83) VA-SB	( 61) VA-SB	( 55) VA-SB	( 100) VA-SB	( 100) VA-SB	
( 100) VA-SB	( 0)	( 17) VA	( 11) GM-MS-UD	( 27) GM-MS-UD	( 0)	( 0)	
( 0)	( 0)	( 0)	( 6) GM-MS-DI	( 9) GM-TB	( 0)	( 0)	
( 0)	( 0)	( 0)	( 6) GM-TB	( 9) GM	( 0)	( 0)	
( 0)	( 0)	( 0)	( 6) GM	( 0)	( 0)	( 0)	
surficial geology	( 33) AL-CL-LI	( 33) AL-SI-CA	( 50) GT	( 55) GT	( 33) SE-LI	( 100) AL-SI	
( 33) AL-CL-LI	( 33) AL-GA	( 33) AL-SI	( 17) AL-SI	( 18) AL-SI	( 33) GT	( 0)	
( 33) AL-GA	( 33) AL-SI	( 17) AL-CL-LI	( 11) SE-LI	( 9) SE-LI	( 33) GT-CA	( 0)	
( 33) AL-SI	( 0)	( 17) AL	( 6) AL-GA	( 9) GT-CA	( 0)	( 0)	
( 0)	( 0)	( 0)	( 6) AL	( 9) ME-AR	( 0)	( 0)	
( 0)							

( 33 )	WV-FP	( 50 )	MV-FP	( 22 )	WV-FP	( 18 )	BE-WI	( 67 )	MV-SC	( 100 )	WV-FP
( 33 )	NV-LE	( 33 )	WV-FP	( 11 )	WV-TE	( 18 )	MV-SC	( 33 )	MV-TE	( 0 )	
( 33 )	MV-FP	( 17 )	MV-AH	( 11 )	MS-LS	( 9 )	MV-OT	( 0 )		( 0 )	
( 0 )		( 0 )		( 11 )	MV-SC	( 9 )	MV-TE	( 0 )		( 0 )	
( 0 )		( 0 )		( 11 )	BE-WI	( 9 )	BE-X	( 0 )		( 0 )	

( 67) D	( 33) S	( 56) P	( 55) P	(100) P	( 50) P
( 33) S	( 33) D	( 11) D	( 27) U	( 0)	( 50) U
( 0)	( 33) P	( 11) U	( 9) D	( 0)	( 0)
( 0)	( 0)	( 11) S	( 9) S	( 0)	( 0)
( 0)	( 0)	( 6) R	( 0)	( 0)	( 0)

(67) D	(33) S	(44) P	(45) P	(67) P	(50) P
(33) S	(33) D	(22) S	(18) D	(0)	(50) S
(0)	(33) P	(6) D	(9) U	(0)	(0)
(0)	(0)	(6) R	(9) S	(0)	(0)
(0)	(0)	(6) X	(0)	(0)	(0)

( 67) ST	(100) ST	( 89) ST	(100) ST	(100) ST
( 33) UE	( 0)	( 6) X	( 0)	( 0)
( 0)	( 0)	( 6) UE	( 0)	( 0)
( 0)	( 0)	( 0)	( 0)	( 0)
( 0)	( 0)	( 0)	( 0)	( 0)

(33)	N	(67)	X	(78)	X	(82)	X	(67)	X	(100)	X
(33)	TD	(33)	N	(17)	N	(18)	N	(33)	N	(0)	
(33)	X	(0)		(6)	TD	(0)		(0)		(0)	
(0)		(0)		(0)		(0)		(0)		(0)	
(0)		(0)		(0)		(0)		(0)		(0)	

[illegible]

TITLE: KOOTENAI MOONWORTS

97/01/31

\*\*\*\*\* SIMILARITY TABLE \*\*\*\*\*  
\*\*\*\*\* Plot to Plot \*\*\*\*\*

Species Abundance Value: canopy cover (%)  
Maximum Species ID level form PC Data Base (%): 0

		COMMUNITY TYPE AND PLOT NUMBERS																	
Comm.	Key	* BOTAS	* BOTAS	* BOTCR	* BOTCR	* BOTCR	* BOTCR	* BOTCR	* BOTCR	* BOTMI	* BOTMI	* BOTMI	* BOTMI	* BOTMI	* BOTMI	* BOTMI	* BOTMI	* BOTMI	* BOTMI
Type	Index	* C	* C	* C	* E	* E	* E	* E	* E	* N	* N	* N	* N	* N	* N	* N	* N	* N	* N
BOTASC	001	100.0	12.0	15.3	17.7	10.3	100.0	18.4	23.1	13.1	8.0	18.7	8.7	12.0	5.7	6.2	6.4	10.2	11.0
BOTASC	002	12.0	100.0	45.5	40.4	13.9	12.0	37.9	23.8	9.9	34.7	16.5	10.6	100.0	6.4	10.2	6.6	11.0	6.2
BOTASC	003	15.3	45.5	100.0	29.4	21.5	15.3	38.6	23.7	16.6	37.9	39.7	14.9	45.5	6.6	11.0	6.6	11.0	6.2
BOTCRE	001	17.7	40.4	29.4	100.0	17.4	17.7	21.5	8.6	11.1	36.2	23.1	7.1	40.4	2.2	6.5	2.2	6.5	31.7
BOTCRE	002	10.3	13.9	21.5	17.4	100.0	10.3	21.0	9.6	20.3	15.1	20.9	37.3	13.9	10.7	15.8	10.7	15.8	6.6
BOTCRE	003	100.0	12.0	15.3	17.7	10.3	100.0	18.4	23.1	13.1	8.0	18.7	8.7	12.0	5.7	6.2	6.4	10.2	11.0
BOTCRE	004	18.4	37.9	38.6	21.5	21.0	18.4	100.0	27.0	14.0	24.2	13.7	17.2	37.9	14.6	14.1	14.6	14.1	2.6
BOTCRE	005	23.1	23.8	23.7	8.6	9.6	23.1	27.0	100.0	4.8	7.9	10.9	4.8	23.8	6.2	2.6	6.2	2.6	31.7
BOTCRE	006	13.1	9.9	16.6	11.1	20.3	13.1	14.0	4.8	100.0	6.2	17.2	35.0	9.9	57.6	57.6	57.6	57.6	31.7
BOTMIN	001	8.0	34.7	37.9	36.2	15.1	8.0	24.2	7.9	6.2	100.0	27.2	12.1	34.7	2.8	6.6	2.8	6.6	6.6
BOTMIN	002	18.7	16.5	39.7	23.1	20.9	18.7	13.7	10.9	17.2	27.2	100.0	6.5	16.5	3.3	22.1	3.3	22.1	6.6
BOTMIN	003	8.7	10.6	14.9	7.1	37.3	8.7	17.2	4.8	35.0	12.1	6.5	100.0	10.6	40.9	28.1	40.9	28.1	6.6
BOTMIN	004	12.0	100.0	45.5	40.4	13.9	12.0	37.9	23.8	9.9	34.7	16.5	10.6	100.0	6.4	10.2	6.4	10.2	6.6
BOTMIN	005	5.7	6.4	6.6	2.2	10.7	5.7	14.6	6.2	57.6	2.8	3.3	40.9	6.4	100.0	27.5	100.0	27.5	6.6
BOTMIN	006	6.2	10.2	11.0	6.5	15.8	6.2	14.1	2.6	31.7	6.6	22.1	28.1	10.2	27.5	100.0	27.5	100.0	6.6
BOTMIN	007	1.8	4.8	7.3	1.8	11.0	1.8	11.9	4.0	61.7	3.0	2.9	38.9	4.8	75.8	30.8	75.8	30.8	6.6
BOTMIN	008	2.7	5.5	9.0	2.3	16.8	2.7	14.6	4.4	17.6	3.1	2.0	27.0	5.5	40.2	18.5	40.2	18.5	6.6
BOTMIN	009	8.0	11.0	10.4	6.0	13.8	8.0	16.0	4.0	74.2	6.7	7.9	36.5	11.0	66.0	31.2	66.0	31.2	6.6
BOTMIN	010	9.7	5.1	6.6	3.4	7.4	9.7	9.2	.6	66.7	4.1	9.3	42.0	5.1	62.4	26.7	62.4	26.7	6.6
BOTMIN	011	8.1	6.3	6.6	6.1	10.7	8.1	10.7	3.7	66.7	6.2	7.3	38.9	6.3	63.0	26.0	63.0	26.0	6.6
BOTMIN	012	15.8	7.1	8.3	4.9	15.0	15.8	20.1	6.8	57.5	3.9	5.2	40.4	7.1	60.2	32.3	60.2	32.3	6.6
BOTMIN	013	5.7	10.7	10.9	5.6	17.4	5.7	21.2	4.8	65.6	7.8	6.8	40.1	10.7	71.0	38.9	71.0	38.9	6.6
BOTMIN	014	12.3	13.7	11.7	8.5	17.0	12.3	23.0	16.8	59.0	8.4	16.9	41.9	13.7	57.9	36.7	57.9	36.7	6.6
BOTMIN	015	5.5	4.9	8.2	3.0	13.3	5.5	12.9	5.4	69.6	3.8	7.4	33.8	4.9	65.2	35.0	65.2	35.0	6.6
BOTMIN	016	5.9	8.1	11.2	5.7	12.5	5.9	18.3	4.2	52.3	10.4	7.0	40.4	8.1	59.5	33.6	59.5	33.6	6.6
BOTMIN	017	12.8	6.6	7.8	4.5	9.4	12.8	7.4	1.4	61.3	4.9	11.7	44.4	6.6	61.4	31.5	61.4	31.5	6.6
BOTMIN	018	1.5	1.8	2.1	1.1	.0	1.5	.0	4.1	.0	.0	.0	.0	1.8	.0	.0	.0	.0	.0
BOTMON	001	9.7	5.1	6.6	3.4	7.4	9.7	9.2	.6	66.7	4.1	9.3	42.0	5.1	62.4	26.7	62.4	26.7	6.6
BOTMON	002	15.8	7.1	8.3	4.9	15.0	15.8	20.1	6.8	57.5	3.9	5.2	40.4	7.1	60.2	32.3	60.2	32.3	6.6
BOTMON	003	5.7	10.7	10.9	5.6	17.4	5.7	21.2	4.8	65.6	7.8	6.8	40.1	10.7	71.0	38.9	71.0	38.9	6.6
BOTMON	004	12.3	13.7	11.7	8.5	17.0	12.3	23.0	16.8	59.0	8.4	16.9	41.9	13.7	57.9	36.7	57.9	36.7	6.6
BOTMON	005	8.7	10.6	14.9	7.1	37.3	8.7	17.2	4.8	35.0	12.1	6.5	100.0	10.6	40.9	28.1	40.9	28.1	6.6
BOTMON	006	15.3	45.5	100.0	29.4	21.5	15.3	38.6	23.7	16.6	37.9	39.7	14.9	45.5	6.6	11.0	6.6	11.0	6.2
BOTMON	007	5.9	8.1	11.2	5.7	12.5	5.9	18.3	4.2	52.3	10.4	7.0	40.4	8.1	59.5	33.6	59.5	33.6	6.6
BOTMON	008	8.0	11.0	10.4	6.0	13.8	8.0	16.0	4.0	74.2	6.7	7.9	36.5	11.0	66.0	31.2	66.0	31.2	6.6
BOTMON	009	8.1	6.3	6.6	6.1	10.7	8.1	10.7	3.7	66.7	4.1	9.3	42.0	5.1	62.4	26.7	62.4	26.7	6.6
BOTMON	010	8.2	8.4	8.1	4.6	12.1	8.2	18.2	4.4	73.1	4.2	6.5	39.7	8.4	64.9	33.3	64.9	33.3	6.6
BOTMON	011	5.1	7.9	9.2	4.6	10.5	5.1	14.5	3.2	53.2	7.9	5.6	33.2	7.9	52.2	27.9	52.2	27.9	6.6
BOTPAR	001	8.1	6.3	6.6	6.1	10.7	8.1	10.7	3.7	66.7	4.1	9.3	38.9	6.3	63.0	26.0	63.0	26.0	6.6

BOTPAR	002	12.3	13.7	11.7	8.5	17.0	12.3	23.0	16.8	59.0	8.4	16.9	41.9	13.7	57.9	36.7
BOTPAR	003	8.2	8.4	8.1	4.6	12.1	8.2	18.2	4.4	73.1	4.2	6.5	39.7	8.4	64.9	33.3
BOTPED	001	5.5	4.9	8.2	3.0	13.3	5.5	12.9	5.4	69.6	3.8	7.4	33.8	4.9	65.2	35.0
BOTPED	002	8.0	11.0	10.4	6.0	13.8	8.0	16.0	4.0	74.2	6.7	7.9	36.5	11.0	66.0	31.2

## TITLE: KOOTENAI MOONWORTS

97/01/31

\*\*\*\*\* SIMILARITY TABLE \*\*\*\*\*  
\*\*\*\*\* Plot to Plot \*\*\*\*\*

Species Abundance Value: canopy cover (%)

Maximum Species ID level form PC Data Base (%): 0

		COMMUNITY TYPE AND PLOT NUMBERS																									
Comm.	Key	* 007 *	* 008 *	* 009 *	* 010 *	* 011 *	* 012 *	* 013 *	* 014 *	* 015 *	* 016 *	* 017 *	* 018 *	* 001 *	* 002 *	* 003 *											
Type	Index																										
BOTASC	001	1.8	2.7	8.0	9.7	8.1	15.8	5.7	12.3	5.5	5.9	12.8	1.5	9.7	15.8	5.7											
BOTASC	002	4.8	5.5	11.0	5.1	6.3	7.1	10.7	13.7	4.9	8.1	6.6	1.8	5.1	7.1	10.7											
BOTASC	003	7.3	9.0	10.4	6.6	6.6	8.3	10.9	11.7	8.2	11.2	7.8	2.1	6.6	8.3	10.9											
BOTCRE	001	1.8	2.3	6.0	3.4	6.1	4.9	5.6	8.5	3.0	5.7	4.5	1.1	3.4	4.9	5.6											
BOTCRE	002	11.0	16.8	13.8	7.4	10.7	15.0	17.4	17.0	13.3	12.5	9.4	.0	7.4	15.0	17.4											
BOTCRE	003	1.8	2.7	8.0	9.7	8.1	15.8	5.7	12.3	5.5	5.9	12.8	1.5	9.7	15.8	5.7											
BOTCRE	004	11.9	14.6	16.0	9.2	10.7	20.1	21.2	23.0	12.9	18.3	7.4	.0	9.2	20.1	21.2											
BOTCRE	005	4.0	4.4	4.0	.6	3.7	6.8	4.8	16.8	5.4	4.2	1.4	4.1	.6	6.8	4.8											
BOTCRE	006	61.7	17.6	74.2	66.7	66.7	57.5	65.6	59.0	69.6	52.3	61.3	.0	66.7	57.5	65.6											
BOTMIN	001	3.0	3.1	6.7	4.1	6.2	3.9	7.8	8.4	3.8	10.4	4.9	.0	4.1	3.9	7.8											
BOTMIN	002	2.9	2.0	7.9	9.3	7.3	5.2	6.8	16.9	7.4	7.0	11.7	.0	9.3	5.2	6.8											
BOTMIN	003	38.9	27.0	36.5	42.0	38.9	40.4	40.1	41.9	33.8	40.4	44.4	.0	42.0	40.4	40.1											
BOTMIN	004	4.8	5.5	11.0	5.1	6.3	7.1	10.7	13.7	4.9	8.1	6.6	1.8	5.1	7.1	10.7											
BOTMIN	005	75.8	40.2	66.0	62.4	63.0	60.2	71.0	57.9	65.2	59.5	61.4	.0	62.4	60.2	71.0											
BOTMIN	006	30.8	18.5	31.2	26.7	26.0	32.3	38.9	36.7	35.0	33.6	31.5	.0	26.7	32.3	38.9											
BOTMIN	007	100.0	52.9	67.7	68.5	58.0	59.1	71.7	54.7	68.5	51.6	70.2	.0	68.5	59.1	71.7											
BOTMIN	008	52.9	100.0	26.0	27.0	21.4	19.7	24.4	25.8	28.0	19.7	31.6	.0	27.0	19.7	24.4											
BOTMIN	009	67.7	26.0	100.0	68.5	70.6	64.6	71.7	57.4	79.2	56.7	61.2	.7	68.5	64.6	71.7											
BOTMIN	010	68.5	27.0	68.5	100.0	67.3	52.1	63.5	46.2	73.5	47.4	70.1	.0	100.0	52.1	63.5											
BOTMIN	011	58.0	21.4	70.6	67.3	100.0	56.4	62.8	50.0	66.4	46.7	61.9	.0	67.3	56.4	62.8											
BOTMIN	012	59.1	19.7	64.6	52.1	56.4	100.0	66.9	59.6	59.8	55.5	61.9	.0	52.1	100.0	66.9											
BOTMIN	013	71.7	24.4	71.7	63.5	62.8	66.9	100.0	68.4	70.2	65.5	63.5	.0	63.5	66.9	100.0											
BOTMIN	014	54.7	25.8	57.4	46.2	50.0	59.6	68.4	100.0	54.5	67.9	55.6	.0	46.2	59.6	68.4											
BOTMIN	015	68.5	28.0	79.2	73.5	66.4	59.8	70.2	54.5	100.0	47.3	59.4	.7	73.5	59.8	70.2											
BOTMIN	016	51.6	19.7	56.7	47.4	46.7	55.5	65.5	67.9	47.3	100.0	52.2	.0	47.4	55.5	65.5											
BOTMIN	017	70.2	31.6	61.2	70.1	61.9	61.9	63.5	55.6	59.4	52.2	100.0	.0	70.1	61.9	63.5											
BOTMIN	018	.0	.0	.7	.0	.0	.0	.0	.0	.7	.0	.0	100.0	.0	.0	.0											
BOTMON	001	68.5	27.0	68.5	100.0	67.3	52.1	63.5	46.2	73.5	47.4	70.1	.0	100.0	52.1	63.5											
BOTMON	002	59.1	19.7	64.6	52.1	56.4	100.0	66.9	59.6	59.8	55.5	61.9	.0	52.1	100.0	66.9											
BOTMON	003	71.7	24.4	71.7	63.5	62.8	66.9	100.0	68.4	70.2	65.5	63.5	.0	63.5	66.9	100.0											
BOTMON	004	54.7	25.8	57.4	46.2	50.0	59.6	68.4	100.0	54.5	67.9	55.6	.0	46.2	59.6	68.4											
BOTMON	005	38.9	27.0	36.5	42.0	38.9	40.4	40.1	41.9	33.8	40.4	44.4	.0	42.0	40.4	40.1											
BOTMON	006	7.3	9.0	10.4	6.6	6.6	8.3	10.9	11.7	8.2	11.2	7.8	2.1	6.6	8.3	10.9											
BOTMON	007	51.6	19.7	56.7	47.4	46.7	55.5	65.5	67.9	47.3	100.0	52.2	.0	47.4	55.5	65.5											
BOTMON	008	67.7	26.0	100.0	68.5	70.6	64.6	71.7	57.4	79.2	56.7	61.2	.7	68.5	64.6	71.7											
BOTMON	009	58.0	21.4	70.6	67.3	100.0	56.4	62.8	50.0	66.4	46.7	61.9	.0	67.3	56.4	62.8											
BOTMON	010	70.9	20.9	72.6	66.2	66.9	65.8	81.8	64.4	70.1	60.6	65.7	.0	66.2	65.8	81.8											
BOTMON	011	58.4	17.7	59.2	50.0	53.3	58.2	58.1	50.0	53.1	53.5	68.0	.0	50.0	58.2	58.1											
BOTPAR	001	58.0	21.4	70.6	67.3	100.0	56.4	62.8	50.0	66.4	46.7	61.9	.0	67.3	56.4	62.8											

BOTPAR	002	54.7	25.8	57.4	46.2	50.0	59.6	68.4	100.0	54.5	67.9	55.6	.0	46.2	59.6	68.4
BOTPAR	003	70.9	20.9	72.6	66.2	66.9	65.8	81.8	64.4	70.1	60.6	65.7	.0	66.2	65.8	81.8
BOTPED	001	68.5	28.0	79.2	73.5	66.4	59.8	70.2	54.5	100.0	47.3	59.4	.7	73.5	59.8	70.2
BOTPED	002	67.7	26.0	100.0	68.5	70.6	64.6	71.7	57.4	79.2	56.7	61.2	.7	68.5	64.6	71.7



## TITLE: KOOTENAI MOONWORTS

97/01/31

\*\*\*\*\* SIMILARITY TABLE \*\*\*\*\*  
\*\*\*\*\* Plot to Plot \*\*\*\*\*

Species Abundance Value: canopy cover (%)

Maximum Species ID level form PC Data Base (%): 0

## COMMUNITY TYPE AND PLOT NUMBERS

*****		*****																		*****	
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BOTPAR	002	100.0	41.9	11.7	67.9	57.4	50.0	64.4	50.0	50.0	100.0	64.4	54.5	57.4
BOTPAR	003	64.4	39.7	8.1	60.6	72.6	66.9	100.0	58.9	66.9	64.4	100.0	70.1	72.6
BOTPED	001	54.5	33.8	8.2	47.3	79.2	66.4	70.1	53.1	66.4	54.5	70.1	100.0	79.2
BOTPED	002	57.4	36.5	10.4	56.7	100.0	70.6	72.6	59.2	70.6	57.4	72.6	79.2	100.0

TITLE: KOOTENAI MOONWORTS

97/01/31

\*\*\*\*\* COMMUNITY TYPE SIMILARITY TABLE \*\*\*\*\*  
\*\*\*\*\* Strata to Strata \*\*\*\*\*

Species Abundance Value: canopy cover (%)  
Maximum Species ID level (%): 0

COMMUNITY TYPE NAMES									
Community Type Name	*BOTASC * N = 3	*BOTCRE * N = 6	*BOTMIN * N = 18	*BOTMON * N = 11	*BOTPAR * N = 3	*BOTPED * N = 2			
BOTASC	100.0	46.4	34.1	34.9	19.1	14.4			
BOTCRE	46.4	100.0	43.1	50.6	34.0	28.0			
BOTMIN	34.1	43.1	100.0	59.2	40.9	33.0			
BOTMON	34.9	50.6	59.2	100.0	66.0	53.5			
BOTPAR	19.1	34.0	40.9	66.0	100.0	62.2			
BOTPED	14.4	28.0	33.0	53.5	62.2	100.0			

97/01/31

Species Abundance Value: canopy cover (%)  
Minimum Species ID level (%): 0

\*\*\*\*\* COMMUNITY TYPE / PLOT SIMILARITY TABLE \*\*\*\*\*  
\*\*\*\*\* Plot to Strata \*\*\*\*\*

		COMMUNITY TYPE NAMES									
ECODATA	Key	*BOTASC	*BOTCRE	*BOTMIN	*BOTMON	*BOTPAR	*BOTPED				
Comm	Index	N = 3	N = 6	N = 18	N = 11	N = 3	N = 2				
ype											
BOTASC	001	49.2	27.3	10.8	16.1	12.6	8.3				
BOTASC	002	62.9	28.6	26.6	22.9	11.9	11.0				
BOTASC	003	61.0	25.4	20.4	31.5	12.8	11.9				
BOTCRE	001	42.7	39.3	22.6	18.1	11.1	5.7				
BOTCRE	002	21.0	41.8	16.1	29.7	16.8	14.3				
BOTCRE	003	49.2	27.3	10.8	16.1	12.6	8.3				
BOTCRE	004	39.4	39.8	22.6	32.5	25.4	18.8				
BOTCRE	005	29.6	40.6	13.3	16.4	15.6	5.0				
BOTCRE	006	19.8	32.6	26.2	45.0	60.5	69.6				
BOTMIN	001	33.0	20.1	21.0	18.6	10.2	7.0				
BOTMIN	002	31.1	19.0	22.8	20.0	17.4	10.9				
BOTMIN	003	15.0	35.6	31.0	53.3	39.3	35.1				
BOTMIN	004	62.9	28.6	26.6	22.9	11.9	11.0				
BOTMIN	005	9.9	24.5	32.2	48.9	58.9	63.6				
BOTMIN	006	13.3	20.4	30.2	26.5	31.8	35.0				
BOTMIN	007	7.6	22.9	28.1	44.7	59.1	65.0				
BOTMIN	008	8.2	11.9	13.7	18.1	22.8	25.8				
BOTMIN	009	13.4	27.4	30.9	51.9	61.7	94.0				
BOTMIN	010	13.1	23.7	29.6	48.3	56.9	68.6				
BOTMIN	011	12.6	25.1	30.5	50.6	79.0	66.7				
BOTMIN	012	13.8	28.2	29.8	49.2	58.9	62.0				
BOTMIN	013	13.3	27.6	32.4	54.3	67.6	70.8				
BOTMIN	014	15.9	30.2	32.0	50.6	59.0	55.9				
BOTMIN	015	7.7	23.5	26.4	44.1	59.0	86.6				
BOTMIN	016	10.5	25.6	28.7	45.5	54.1	53.0				
BOTMIN	017	14.9	24.6	28.5	44.2	57.2	57.3				
BOTMIN	018	2.6	3.9	47.9	1.3	.0	.6				
BOTMON	001	13.1	23.7	29.6	48.3	56.9	68.6				
BOTMON	002	13.8	28.2	29.8	49.2	58.9	62.0				
BOTMON	003	13.3	27.6	32.4	54.3	67.6	70.8				
BOTMON	004	15.9	30.2	32.0	50.6	70.9	55.9				
BOTMON	005	15.0	35.6	31.0	53.3	39.3	35.1				
BOTMON	006	61.0	25.4	20.4	31.5	12.8	11.9				
BOTMON	007	10.5	25.6	28.7	45.5	54.1	53.0				
BOTMON	008	13.4	27.4	30.9	51.9	61.7	94.0				
BOTMON	009	12.6	25.1	30.5	50.6	79.0	66.7				
BOTMON	010	11.5	25.8	27.6	49.6	70.9	70.1				
BOTMON	011	10.2	24.6	28.1	51.0	53.4	55.8				
BOTPAR	001	12.6	25.1	30.5	50.6	79.0	66.7				



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ACOCOL	30					1		5	1				3	10			1			
POPTRI					5															
ACTRUB	10								1						1	3				
LINBOR		3					1													
CORCAN		1				10	3													
ALNSIN		3					100					50								
SYMALB		10	3	10	5			1			5	50		3		3				
BOTVIR			1																	
RHAALN			5										30	70	20	4				
ANGELICA SP.			1	10	3			10							3		10			
CLIUNI						3														
TRIOVA						5														
SANMAR							30													
LONCIL							3	3						1	1					
PYRASA									1											
EQUHYM									1	1		1	10	1						
VIOCAN											3									
ARANUD											5									
AMEALN											20									
DISHOO																	1			



[illegible]



Zulu Creek Microplot data continued (plots 21-33).

	21	22	23	24	25	26	27	28	29	30	31	32	33
CANOPY	95	92	91	92	95	87	94	95	92	93	86	90	96
COVER	30	10	5	0	1	5	60	10	50	80	10	10	20
MOSS	0	0	0	0	20	0	90	80	3	0	70	80	3
DLITTER	0	0	0	0	0	0	0	0	0	10	0	0	1
CLITTER	90	80	90	0	40	90	10	20	90	90	30	30	90
WOOD	10	20	3	100	40	5	0	0	10	1	0	10	1
TIATRI	10		3			5	30	10	40	50	1	3	10
CLIUNI	5	10	3								5		3
VIOGLA							20	1	20	5			1
VIOORB	10							1			1	1	3
LINBOR						1							
HABSAC	10						10		1				
GOOBL	1												
LISTERA SP.		1											
OSMCHI							1				1	3	
CARDIS							3						
VERAHE											20		
BOTMIN							1/5	1/4	1/8	1/7			1/3
BOTMON											1/6	1/4	1/1
BOTPAR										1/1			
BOTVIR										3/1			

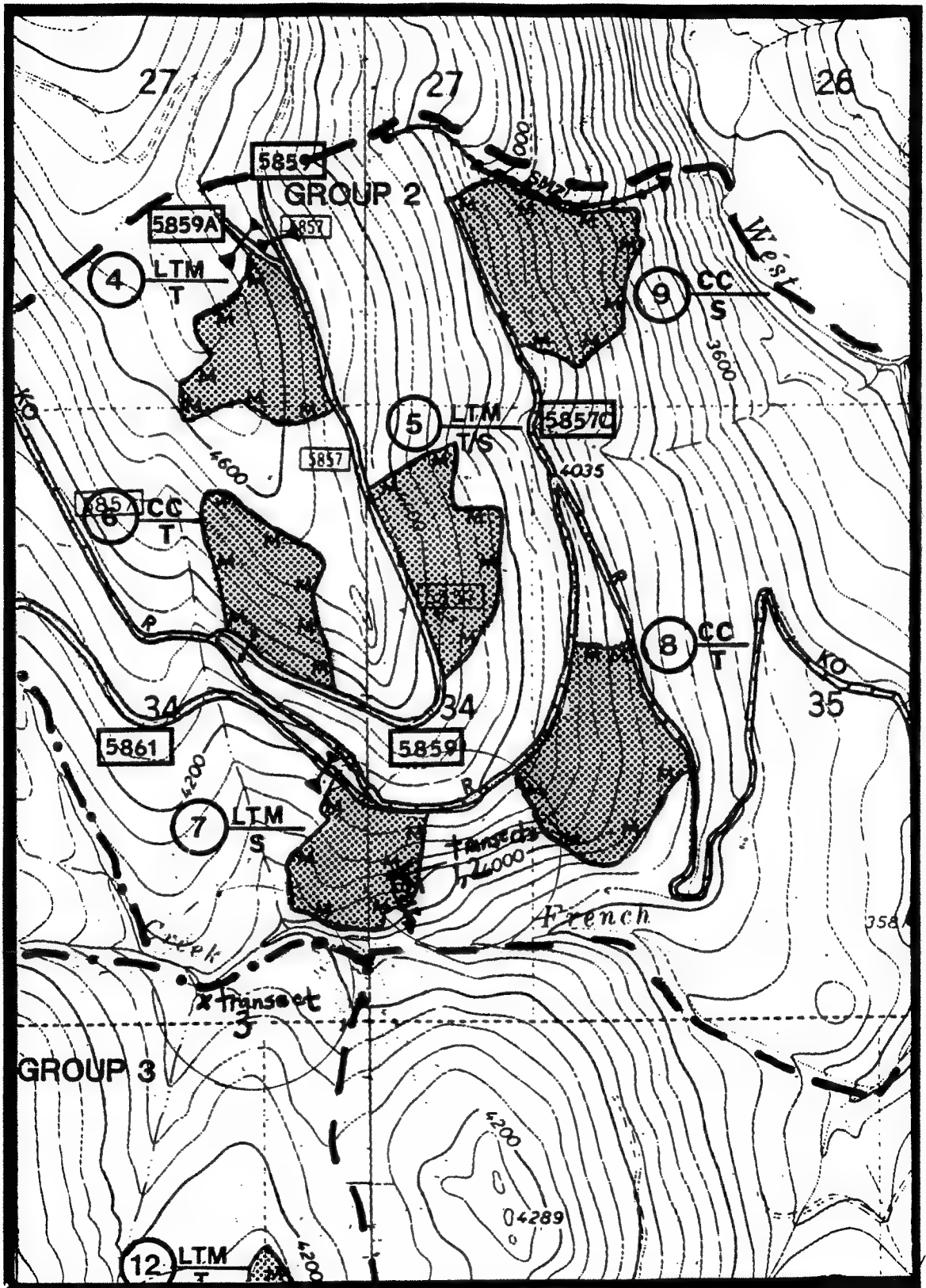
## APPENDIX D: FRENCH CREEK DEMOGRAPHIC MONITORING

Demographic monitoring of Botrychium minganense and B. montanum was initiated to serve as a baseline for determining long term population trends as potentially effected by proposed management activities (logging) in the area and also to study the phenology of these two species over a single growing season. Three permanent belt transects (Lesica 1987) were established in the French Creek drainage (T37N R32W S34 SE1/4) on 15 and 17 July 1995 by Jim Vanderhorst (contractor to Montana Natural Heritage Program) and Leslie Ferguson (Kootenai National Forest Troy District botanist). Two transects are located in proposed cutting unit 7 of the French Mud Pickin's timber sale and a control transect is located outside of the unit (see attached sale map). The transects are accessed by FS Rd 5857. Transects 1 and 2 are located, respectively, on the upper and lower edges of a small seep; this is marked on the sale map as a dot with a curving line with an arrow pointing downhill. Transect 3 is located across French Creek and about 1/3 mile upstream on a small bench just east of a small intermittent tributary.

Each transect is marked by two reinforcing rods driven into the ground at the origin and end of the baseline (Lesica 1987); these are painted orange as are surrounding trees to aid in relocation. A meter tape is strung between the rods as the baseline and two meter sticks are placed perpendicular to this to delineate square meter plots. Transect 1 consists of 5 adjoining square meter plots which are arranged from left to right standing uphill from the baseline. Transect 2 consists of 5 adjoining square meter plots arranged from left to right standing downhill from the baseline. Transect 3 consists of 3 adjoining square meter plots arranged from left to right standing on the north side of the baseline. The origin of each baseline is the left reinforcing rod. The right rod may be somewhat beyond the edge of the last plot in the transect. See the attached diagram for plot layout. Photographic slides of the transects are included in Appendix E (slides 43-50).

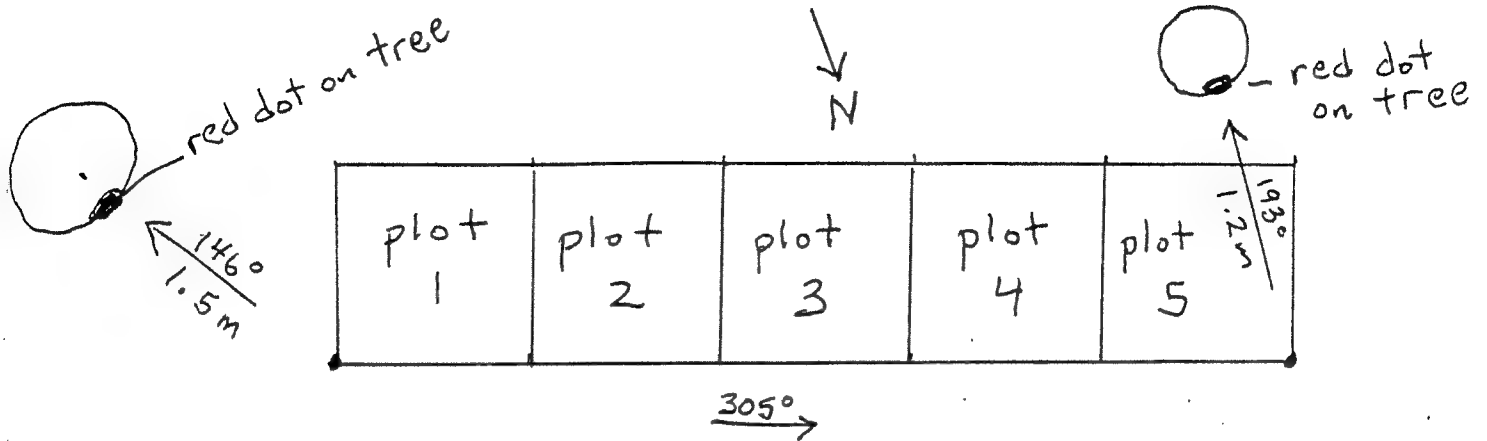
Individual plants of Botrychium minganense and B. montanum were mapped within each square meter plot to the nearest .5 decimeter, each plant was identified to species, its height was measured, and herbivory (nibbling) was noted. The data was recorded on graph paper with each plant represented by a dot accompanied by a code for species (Mi = B. minganense, Mo = B. montanum), height in millimeters, and the letter n if it was nibbled.

Since each plant is mapped in a relocatable grid, the fate of individual plants can be traced over months and years. Transects 1 and 2 were censused in mid-July and early August in 1995 and 1996. Transect 3 was censused in mid-July in both years. Individual plants from the transects were assigned letter codes to follow plant fate over two years. Due to high density of Botrychium montanum plots 1, 4, and 5 in transect 1 were excluded from this analysis. The data for these plants are given in the following tables. Photocopies of raw data from both years is also attached.

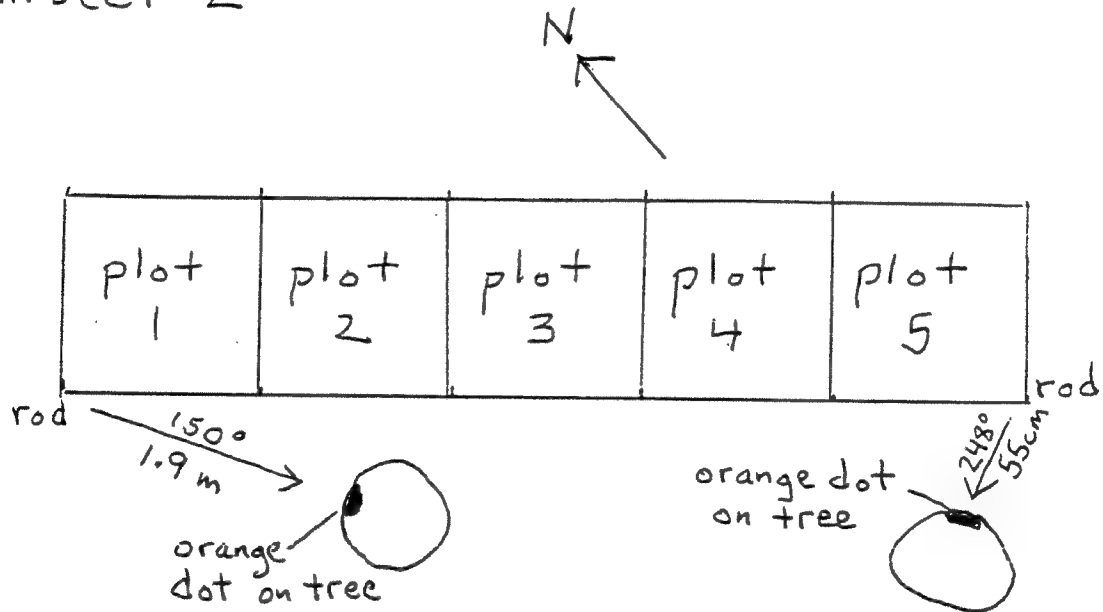


# French Creek Botrychium monitoring

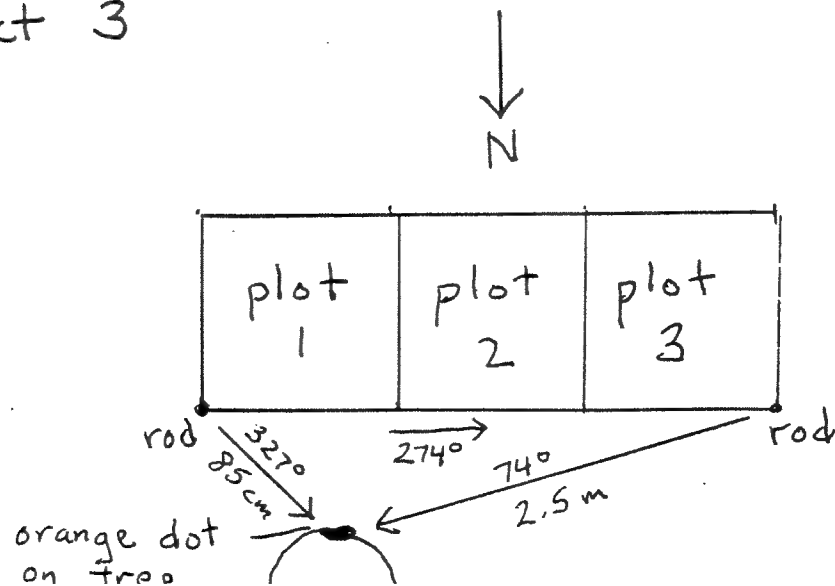
## Transect 1



## Transect 2



## Transect 3



APPENDIX D-TABLES: Heights (mm) of individual moonworts in transects at French Creek on four dates. Missing numbers indicate absence on that date. n = nibbled.

TRANSECT 1 PLOTS 2 and 3 Botrychium montanum

	7/17/95	9/5/95	7/16/96	9/3/96
a	20	35		5n
b	10	15		15
c	12	25		
d	18			
e	15	30		
f	20		20	
g	38	96	36	35n
h	25		30	
i	23			
j	17	24	17	
k	25		15	
l	32	78		
m	10			
n	28	61	11	
o	10			
p	10			
q	20			
r	10			
s	28			
t	15			
u	20			
v	10		28	40
w	15			12
x	20			
y	20	25n	20	
z	20	45		
aa	8		15	
bb	8	27	15	
cc	15		10	
dd	17	50	18	30n
ee	17	50		
ff		20		
gg		13		
hh		8	10	16
ii		31	5	12
jj		74		
kk		35		
ll		12		
mm		35n		
nn		31		
oo		52	10	12
pp			11	20
qq			10	
rr			21	22n
ss			25n	5n
tt			5	
uu				45
vv				20n

**TRANSECT 2 Botrychium minganense**

	7/17/95	9/5/95	7/16/96	9/3/96
a	63	67		
b	104	120	115	
c	25	97	100	110
d	25			
e	95			
f	44	50n		
g	70			
h	90			
i	102			
j	145		120	
k	63			
l	45	47n	32	40
m	10			
n	80	87	45	45n
o	90	20		
p	120	138	75	10n
q		36n	60	70
r		100	40	50n
s		71		
t		50		
u		160		135
v		40n		
w		35n		
x			75	70
y			55	60
z			65	60
aa			24	15n
bb			50n	45n
cc			40n	30n
dd			20n	12n
ee			85	100
ff				30n

**TRANSECT 2 Botrychium montanum**

	7/17/95	9/5/95	7/16/96	9/3/96
a	2n	30		
b	15	41		
c	21	40		
d	17	40		
e		20		
f		36		
g			16	65
h			35	60
i			28	
j				30n
k				25
l				20
m				12
n				15
o				33
p				18
q				22
r				18
				26

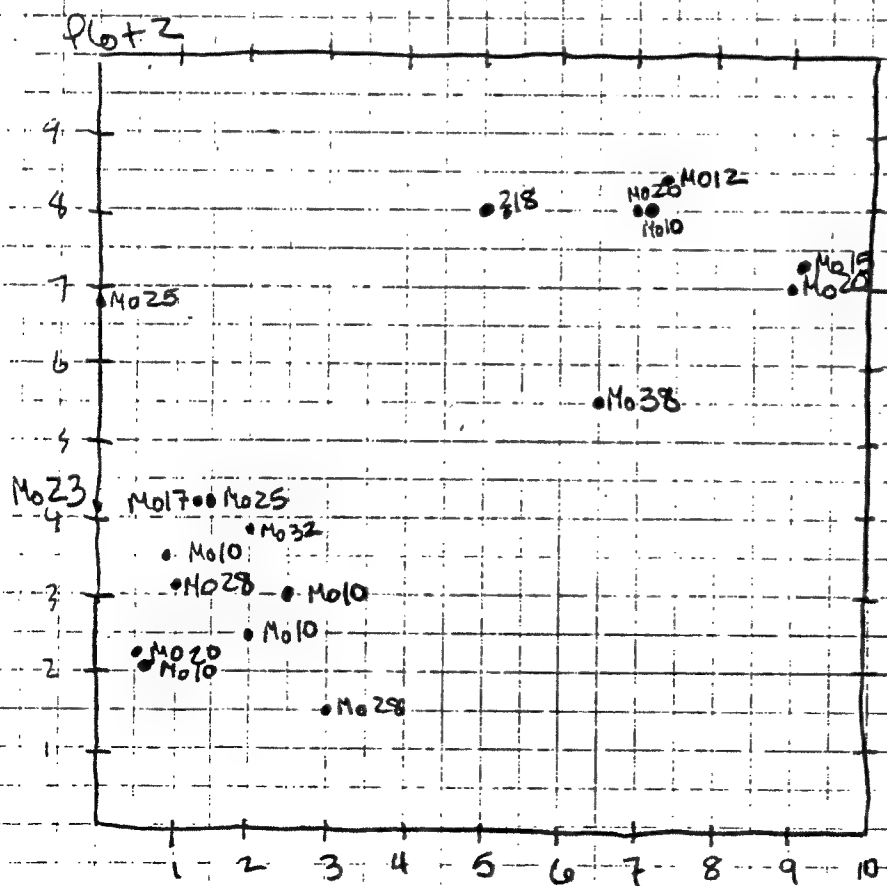
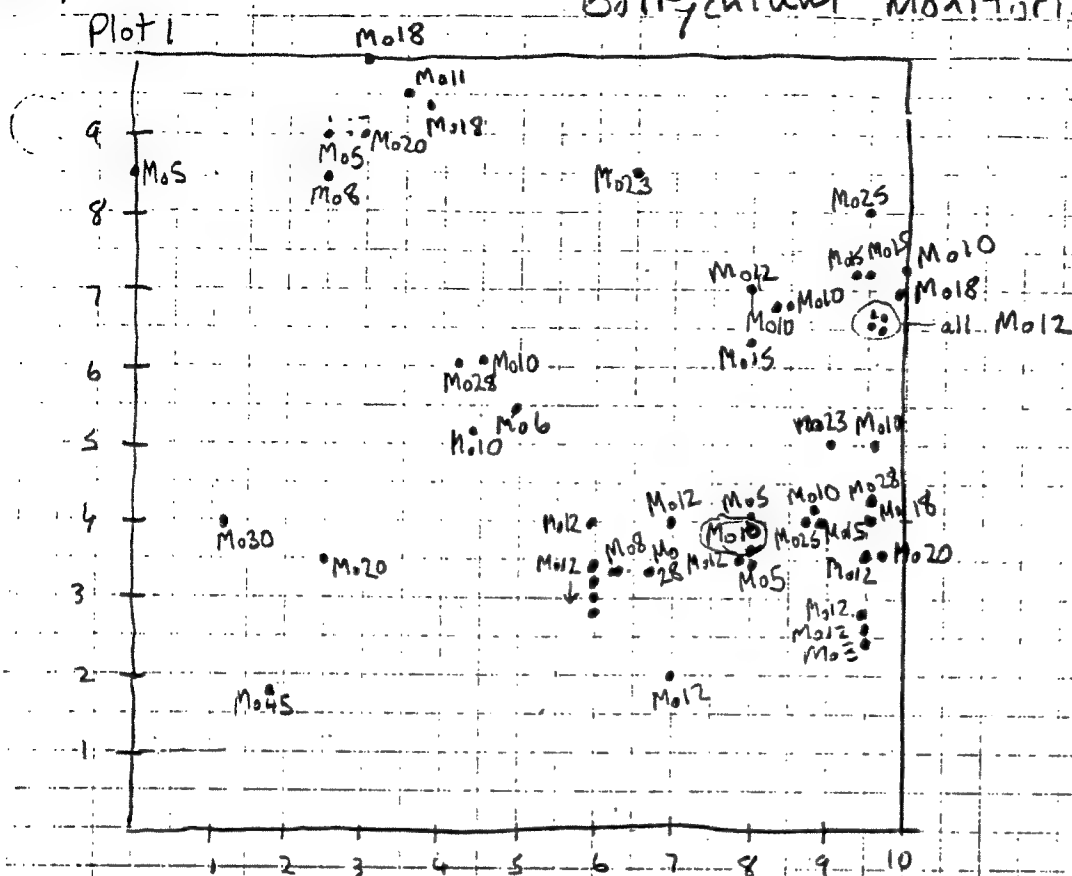
TRANSECT 3 Botrychium minganense

	7/18/95	7/16/96
a	91	83
b	17	55
c	50	
d	73	70
e	77	25
f	50	70
g	62	105n
h	25	75n
i	50	45
j	50	85
k	48	
l	85	83
m	92	100
n	38	67
o	45	70
p	60	68
q	35	80
r	87	
s	25	25
t	118	
u	105	120
v	69	60
w	103	
x	11	80
y	55	48
z	70	65
aa	35	60
bb	142	82n
cc	27	
dd	68	35
ee	48	
ff	80	110
gg		35
hh		67n
ii		38
jj		63
kk		30
ll		83
mm		40
nn		35
oo		42

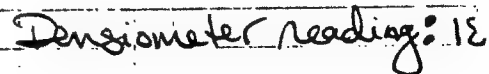
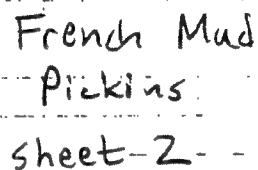
W, 15, 1995

French Mud Ticks Limber Sate

# Botrychium monitoring transect 1





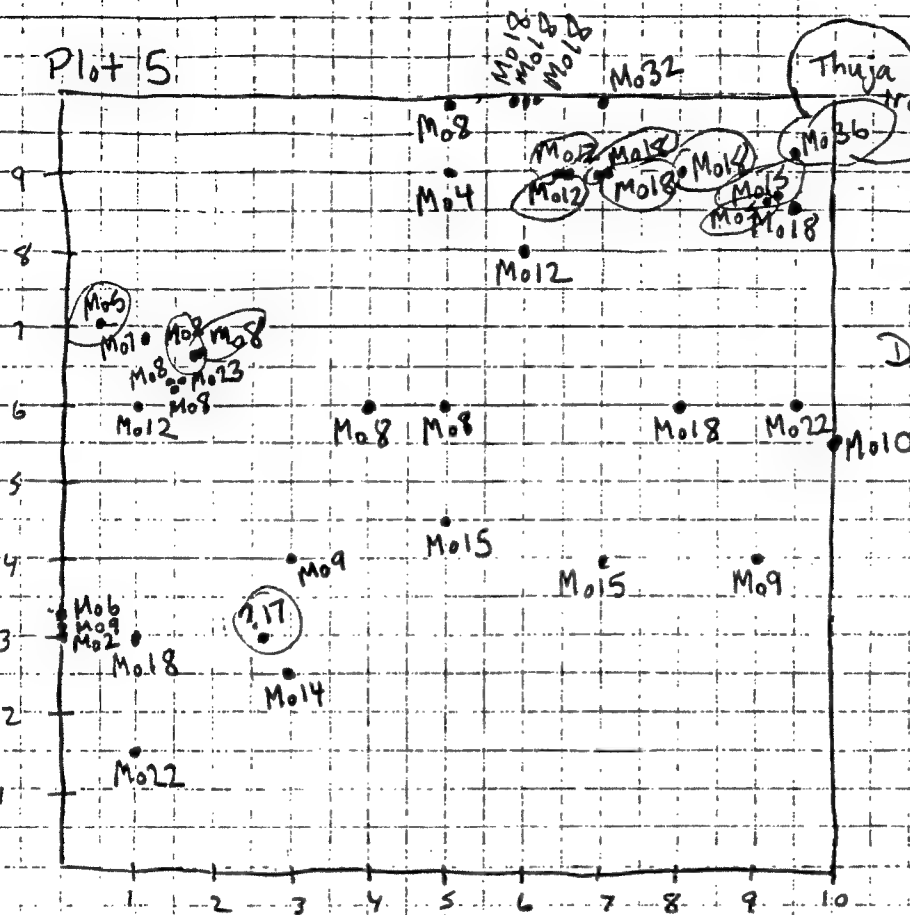


M<sub>0</sub> = *Botrychium montanum*

July 15, 1995

Transect 1

Plot 5



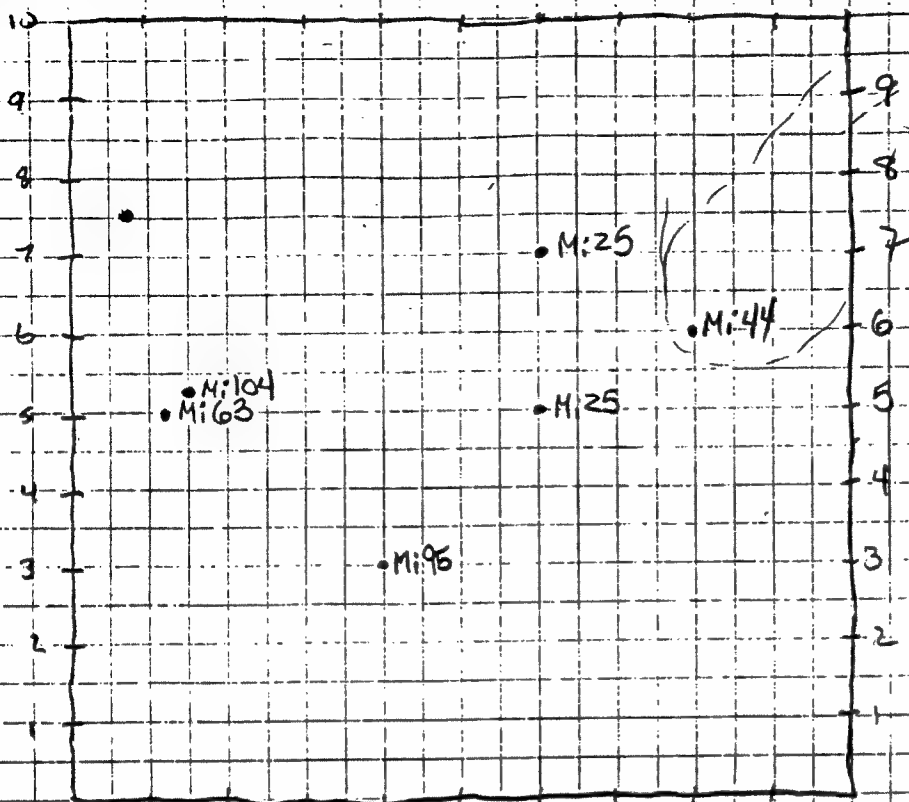
French  
Mud  
pickins sheet 3

Botrychium monitoring

Densimeter reading: 10

French-Mud-Pickings

Plot #1



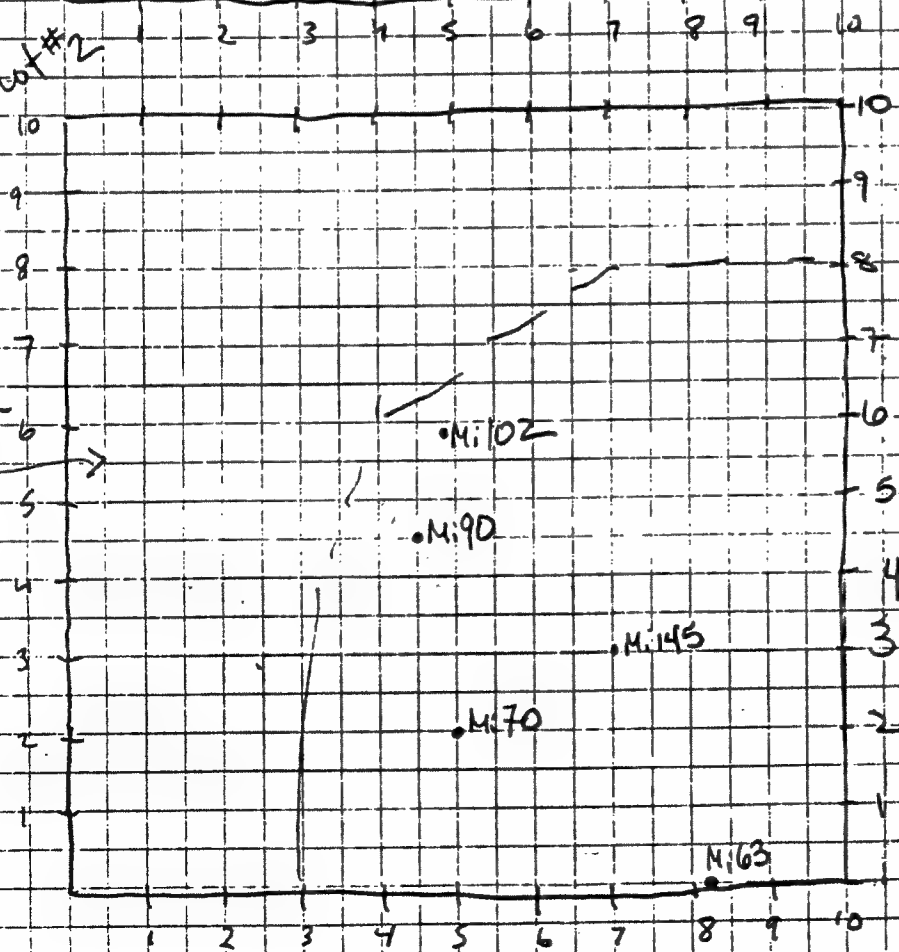
French Mud  
pickings TS  
Botrychium  
monitoring

Transect 2

July 17, 1995

M<sub>0</sub> = *B. montanum*  
M<sub>i</sub> = *B. minganense*

Plot #2



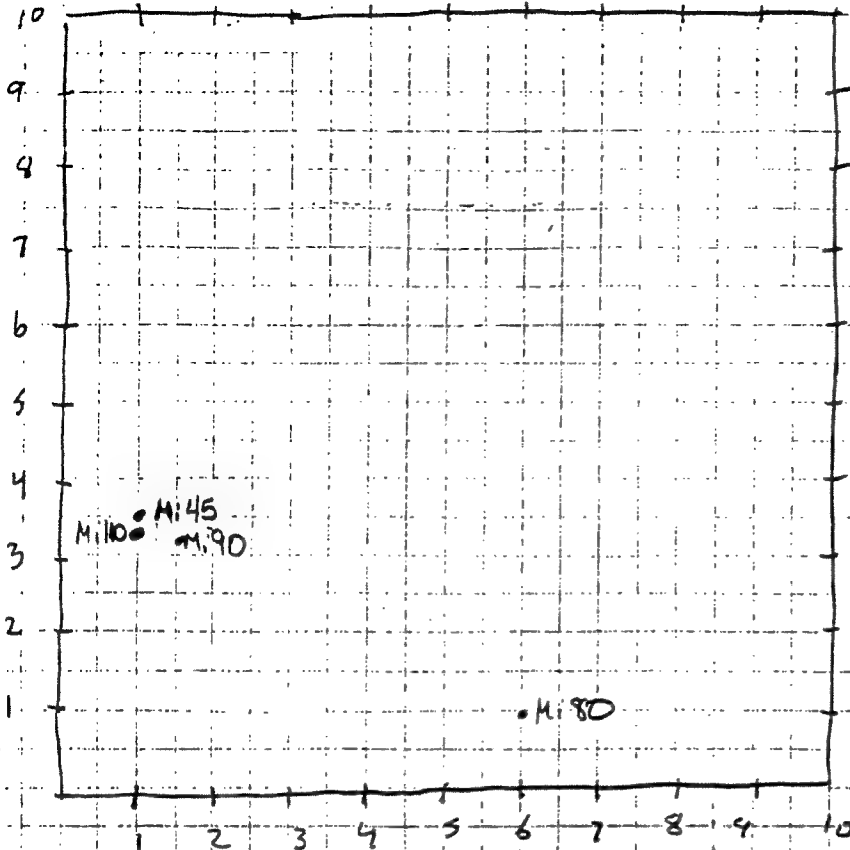
Wet area

French Mud Pickins transect 2

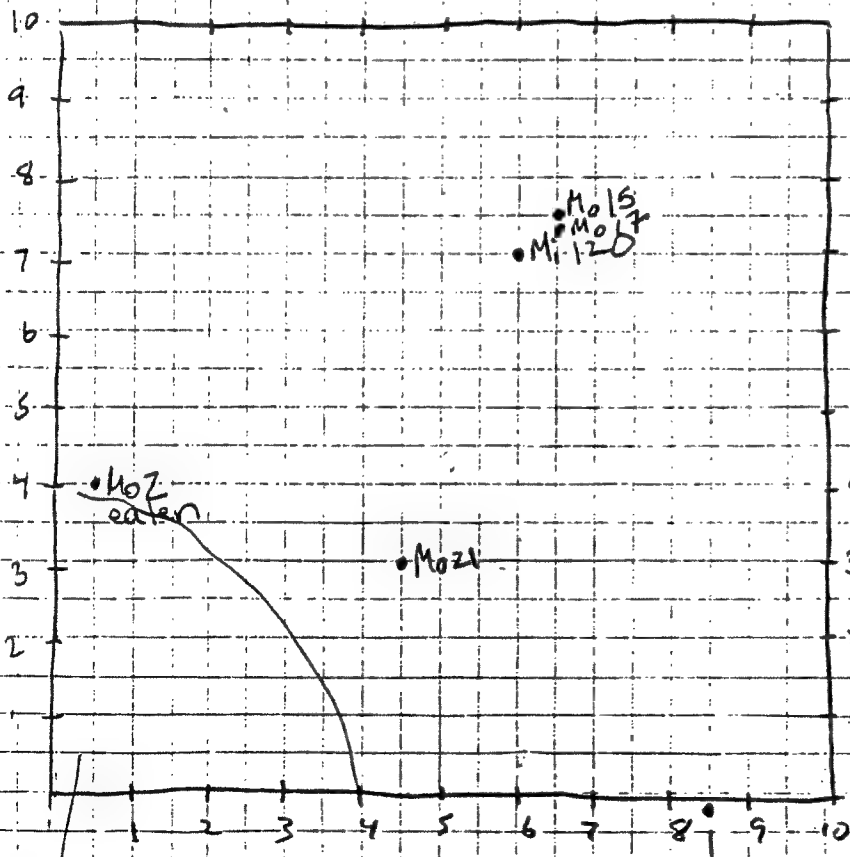
Plot #3

July 17, 1995

plot #4 → all wet  
Void  
no plants



plot #5



Wet area

Mo28  
2 headed freak  
123  
110

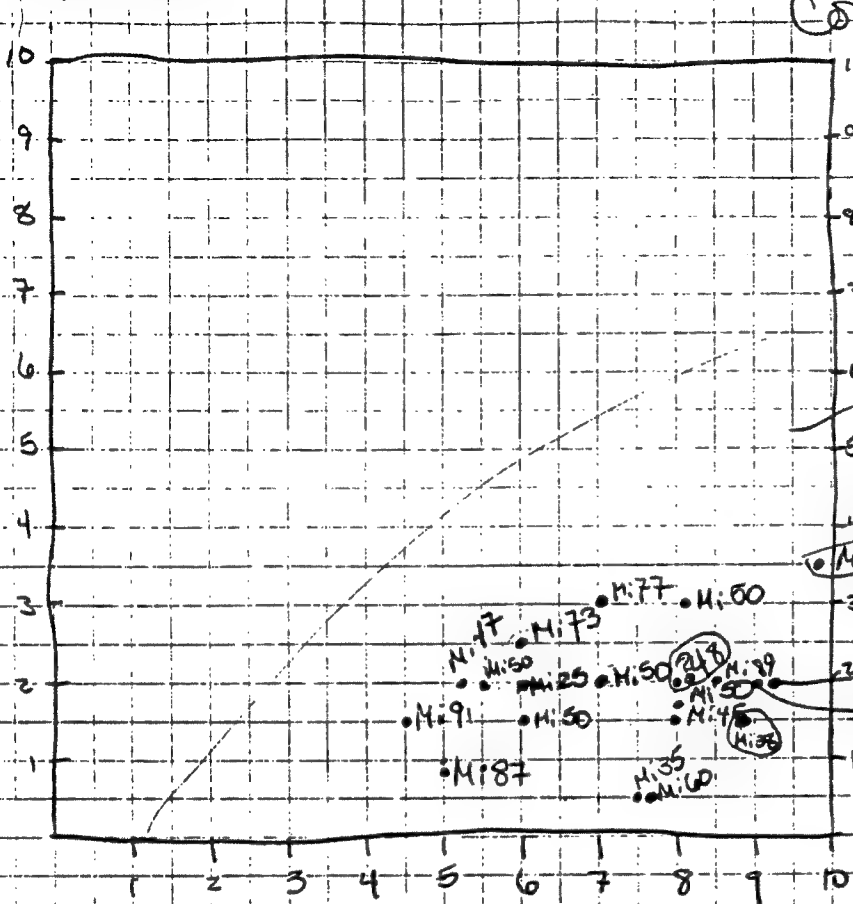
July 17, 1995

Plot #1

French Mudpickens  
Control Plot  
(transect 3)

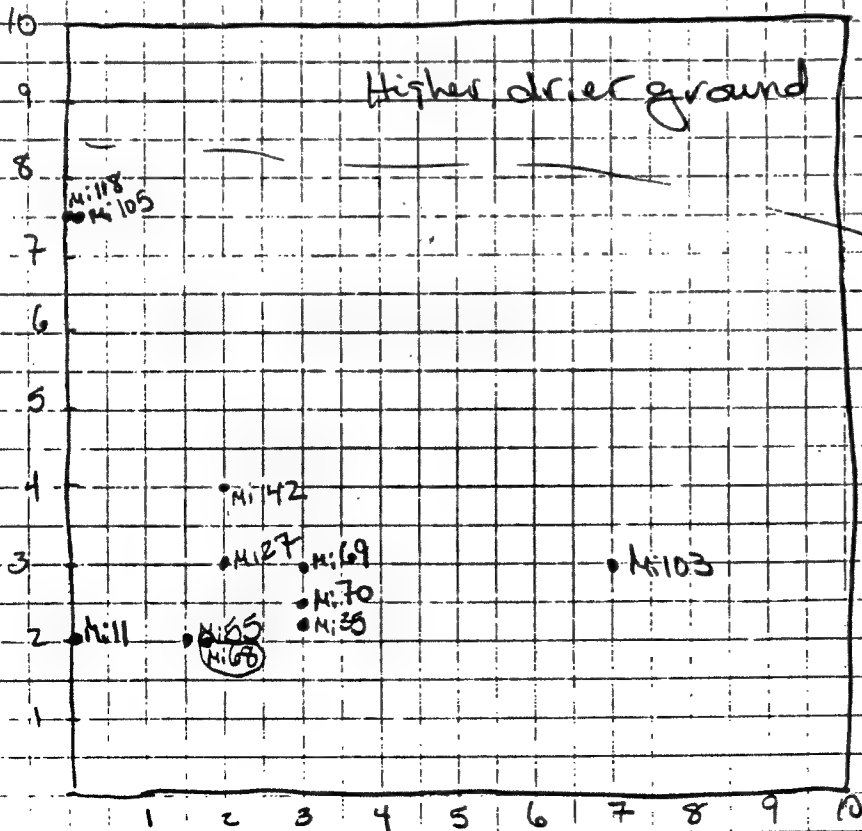
Mi = Botrychium  
ningamense

Swale

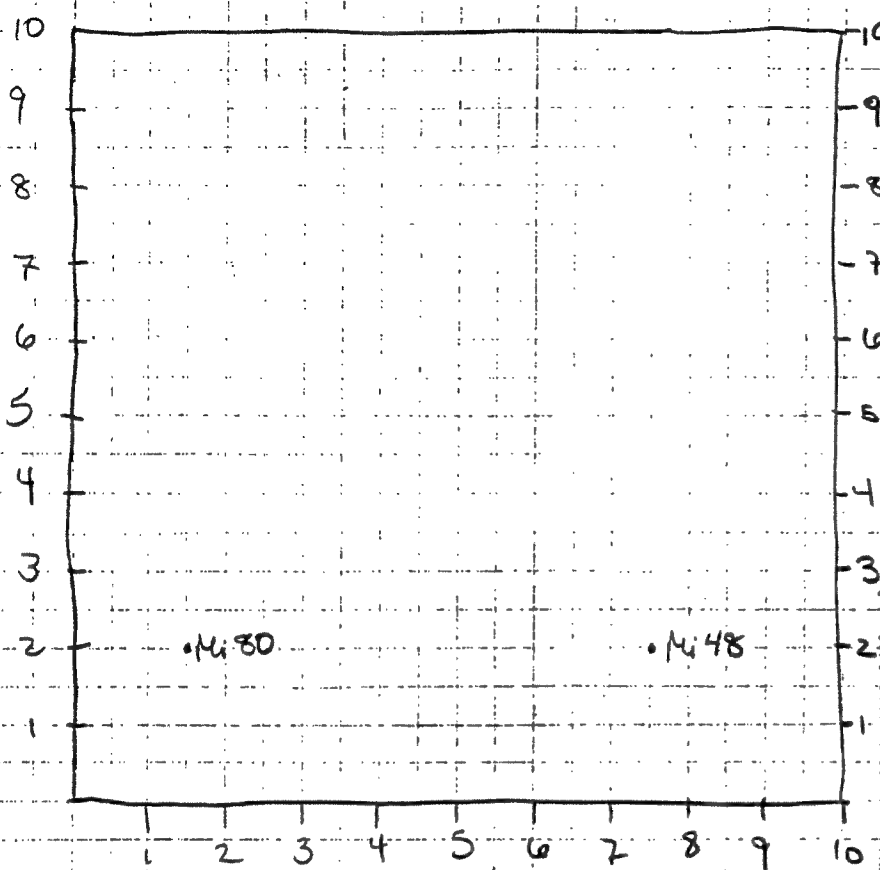


Plot #2

Higher, drier ground



July 17, 1995 French Mudpickens  
Transect 3 (control plot)

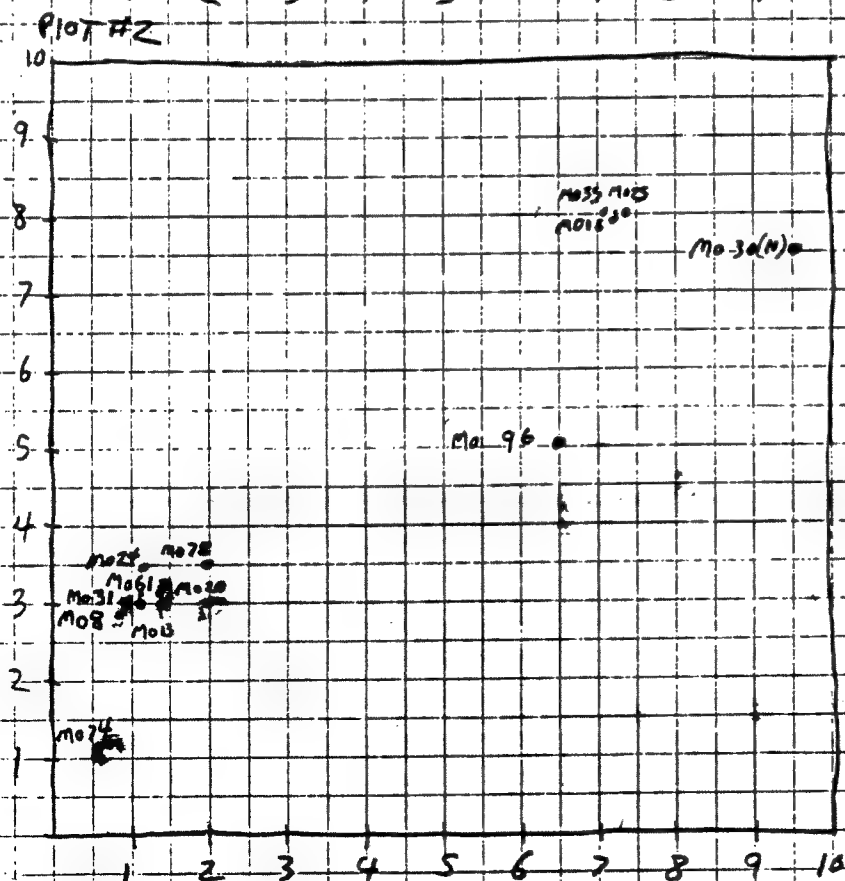
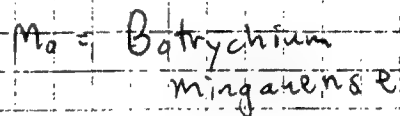


Plot 3

*Goodyera oblongifolia*  
Mass

Trench Mud Pickings  
(N) = nibbled

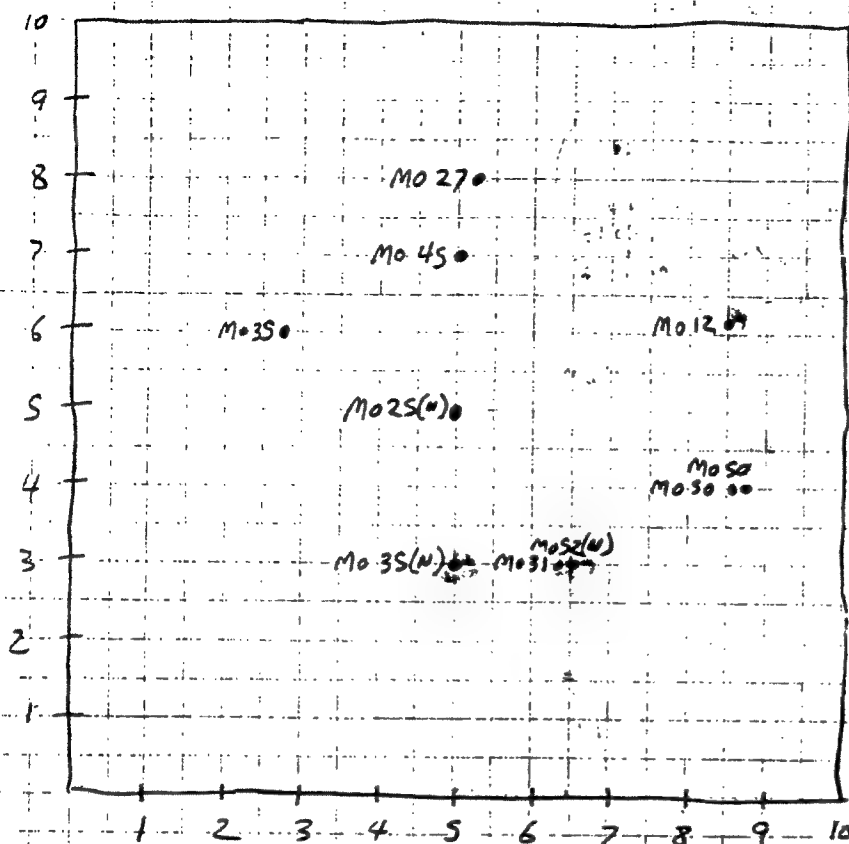
## Transect



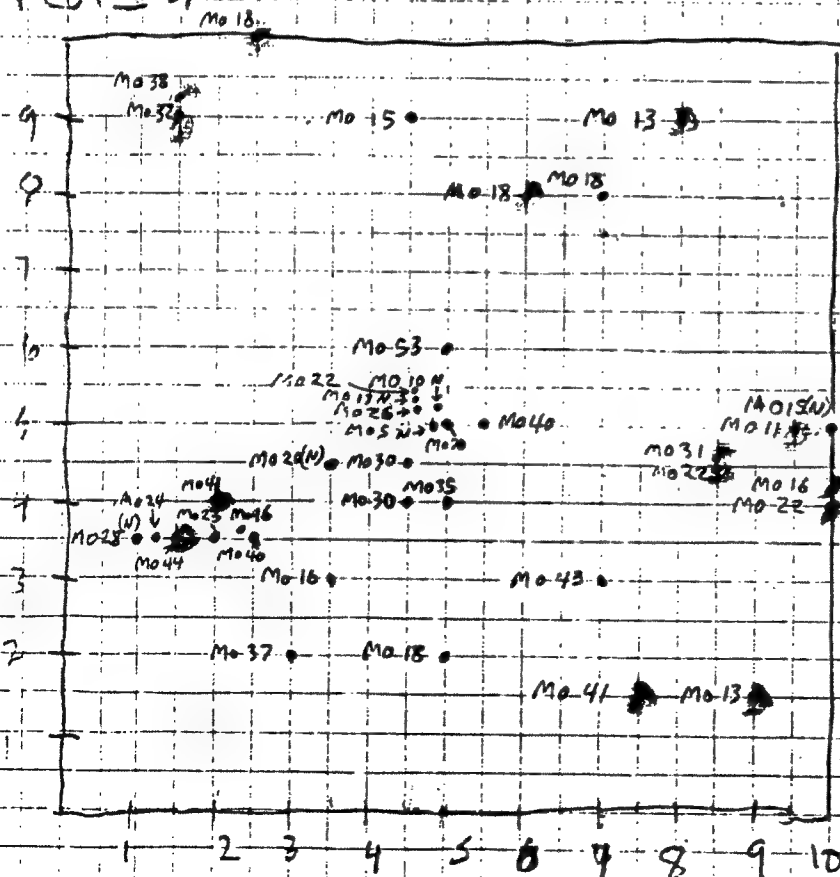
Plot #3

Sept 5, 1995

Trasect 1



Plot #4



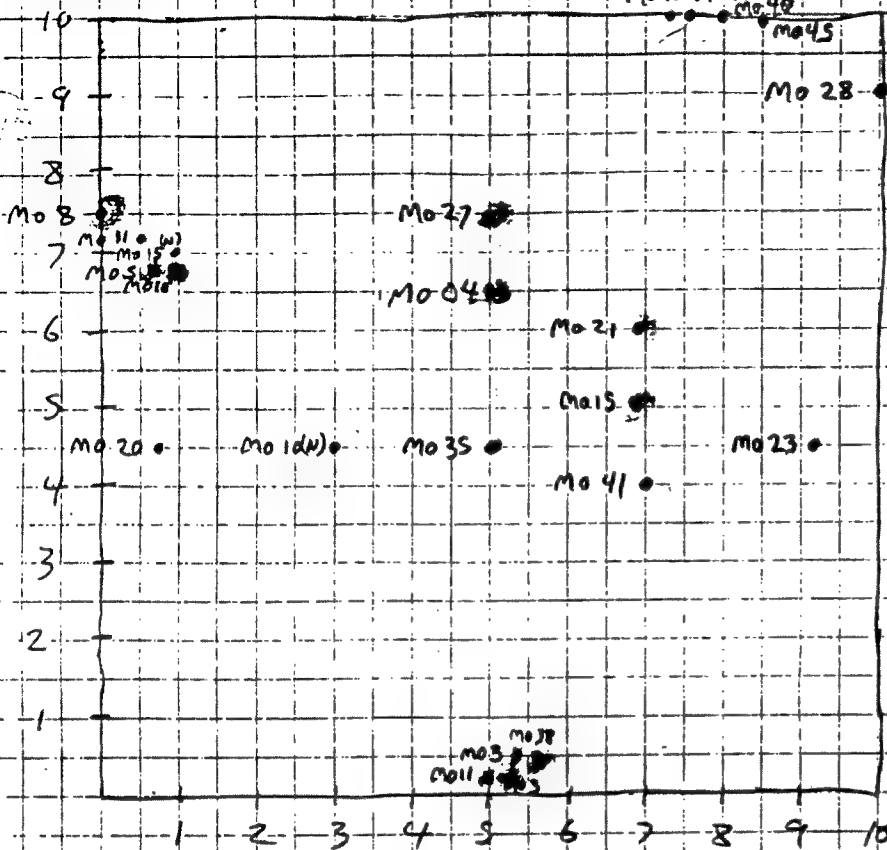


Plot #15

INTERMEDIATE PLANT

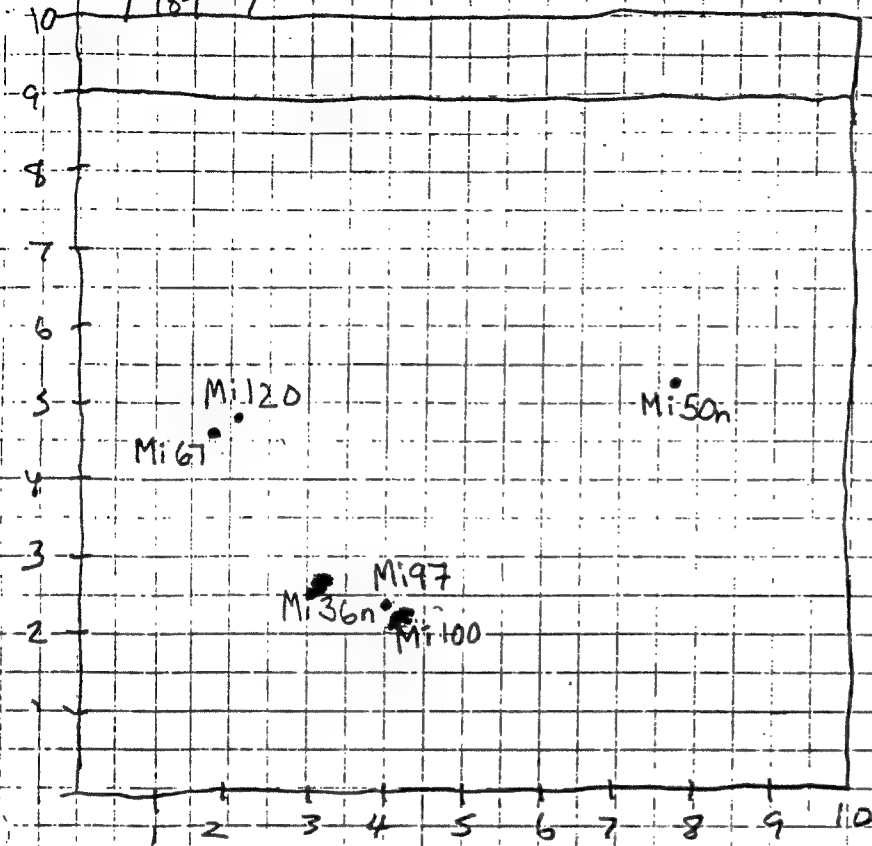
Mo45 Mo45 Mo45 Mo45

Transect 1



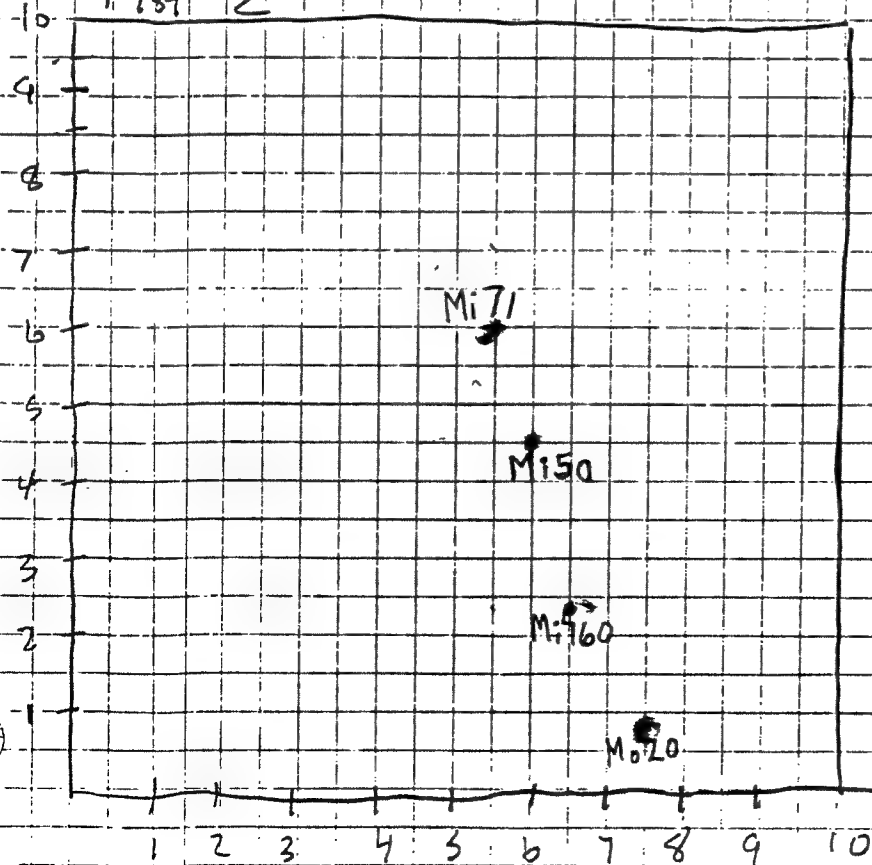
# French Mud Pickings' - Transect 2 Sept 5, 1995

Plot 1



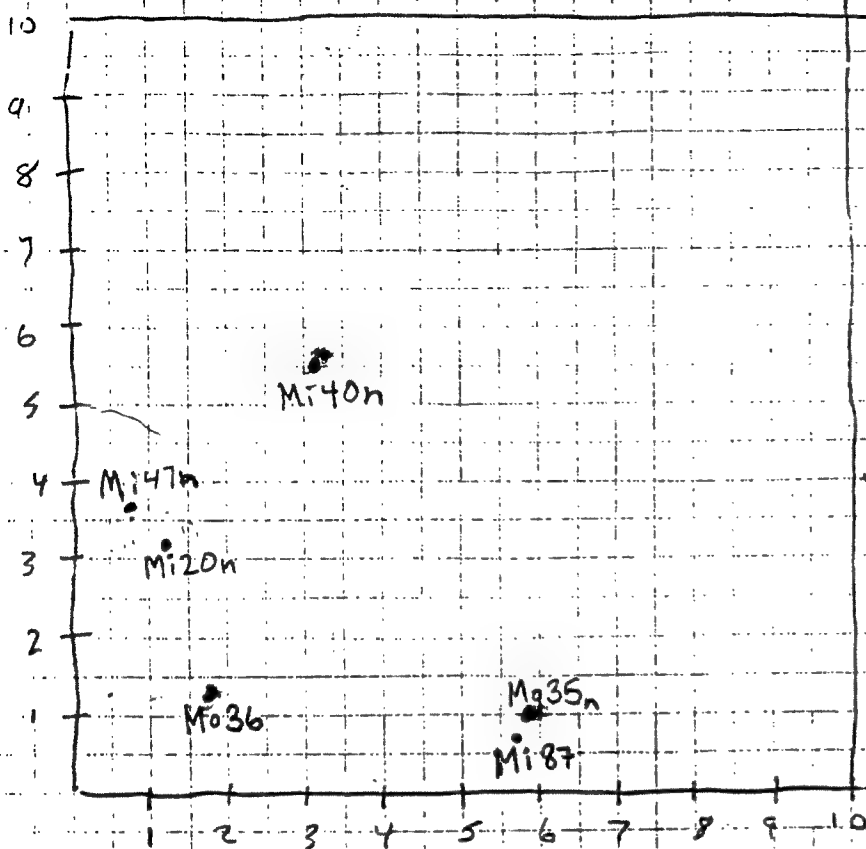
n = nibbles

Plot 2



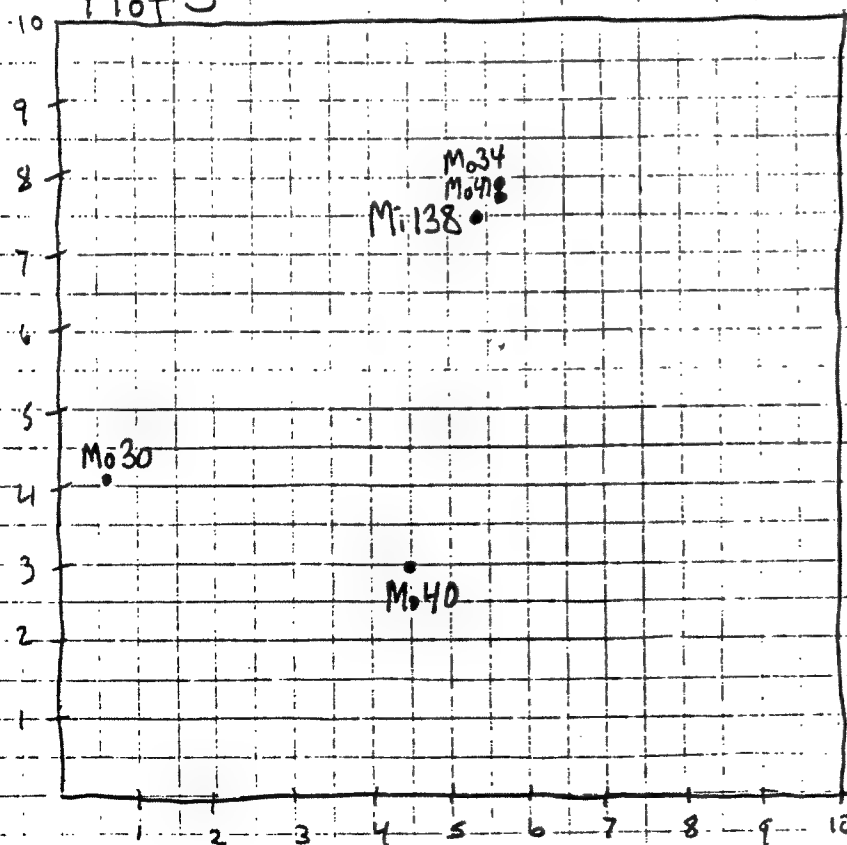
Plot 3

Transect 2 Sept 5 1995



Plot 4 - nhl

Plot 5

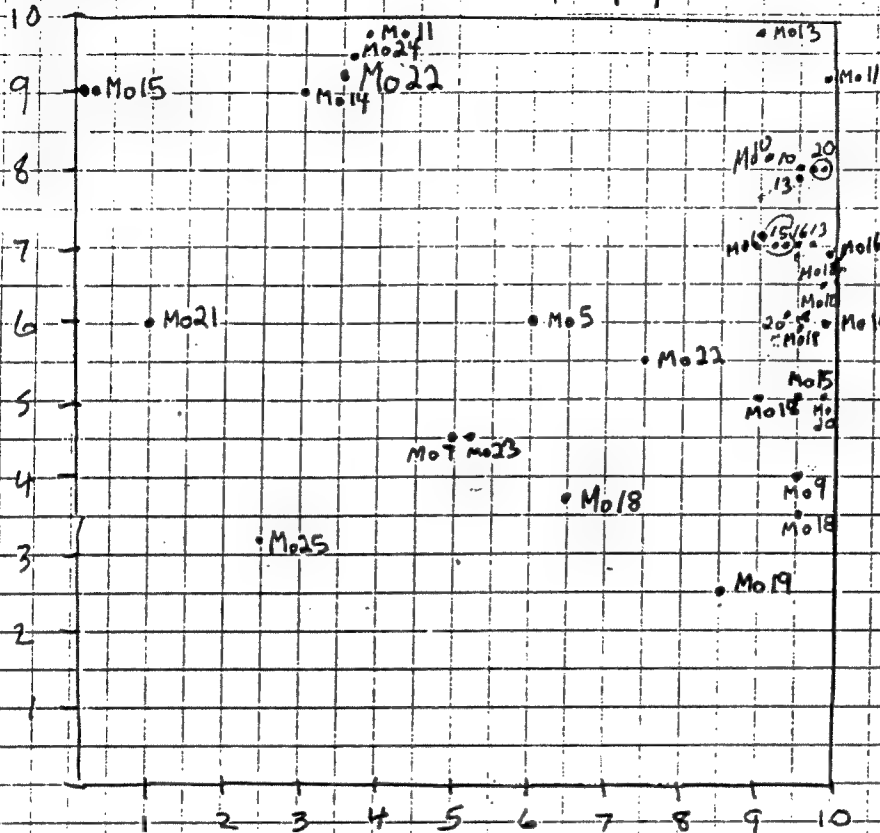


July 16 1996

# French Mud Pickens Timber Sale Botrychium Monitoring Transect #1

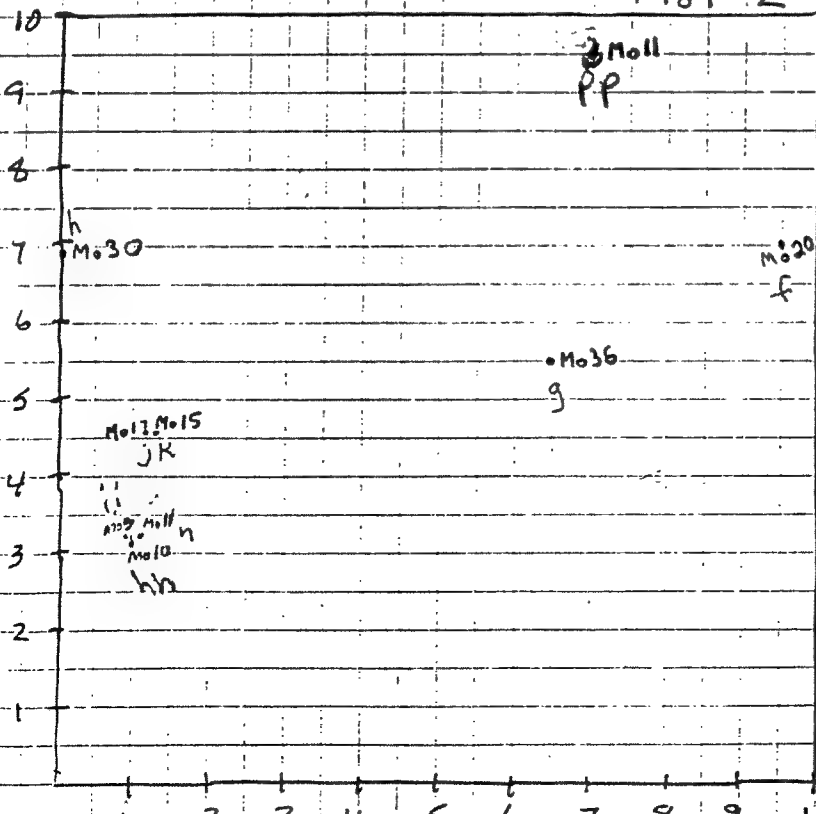
Sheet #1 of 3

Plot 1



t = 39

Plot 2

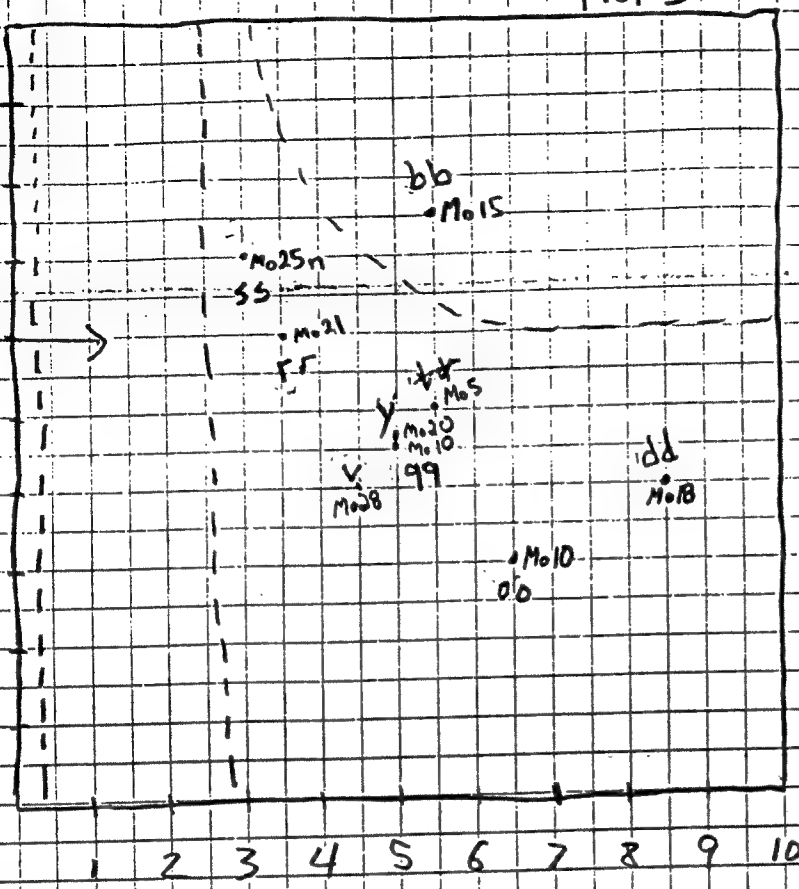


July 16, 1996

Plot 3

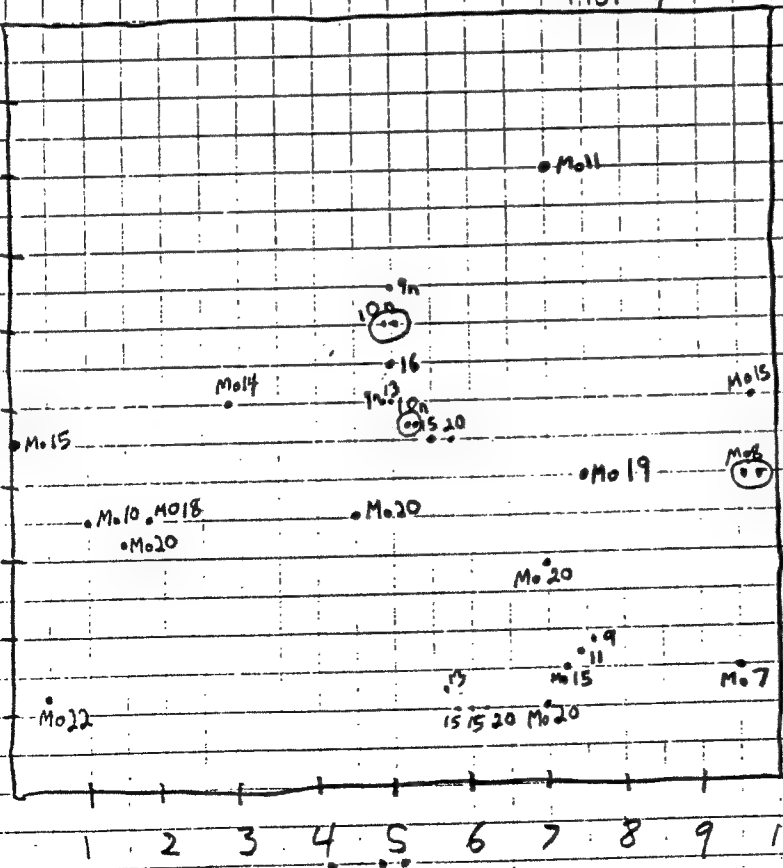
French Mud Pickins  
Sheet #2 of 3  
Transect #1

Decomposed log



Plot 4

+ = 30



Plot 5

"3"

11  
12  
13  
14  
10/2  
M.8

→ Thuja trunk

July 16, 1992

French Mud Pickins  
Sheet #3 of 3  
Transect #1

M.15  
13

M.10

M.11

M.10

M.11

+ z 1.7

1 2 3 4 5 6 7 8 9 10

7

8

7

6

5

4

3

2

1

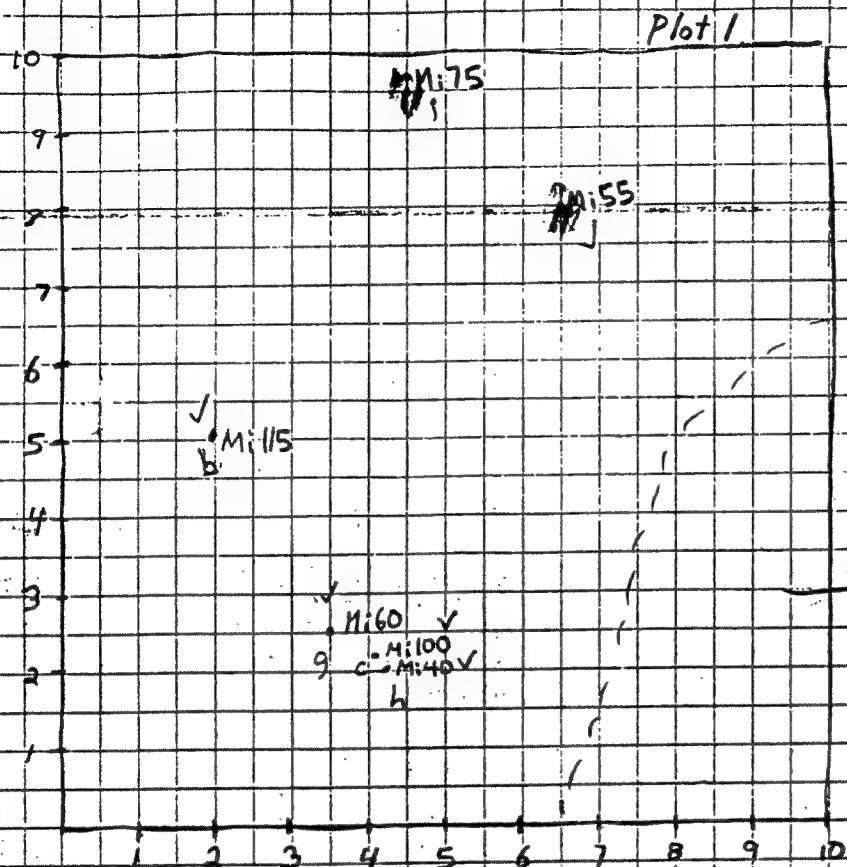
1 2 3 4 5 6 7 8 9 10

July 16, 199

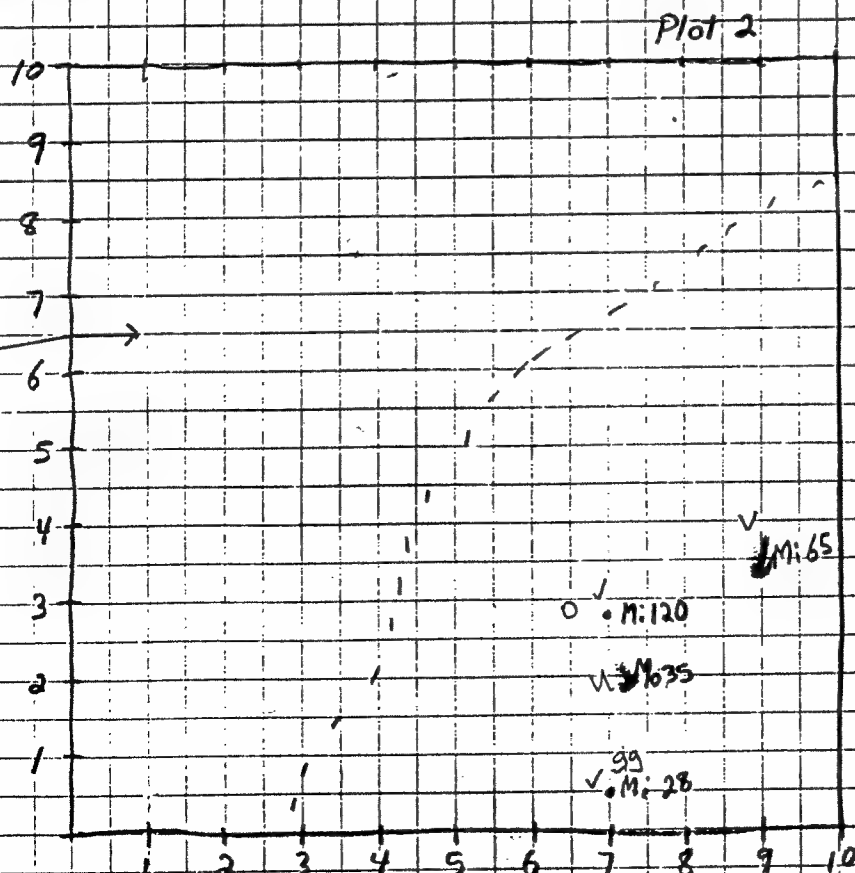
# French Mud Pickins T.S. Botrychium Monitoring

Transect #2  
Sheet #1 of 2

Mo = Montanum  
Mi = Manganense



wet area



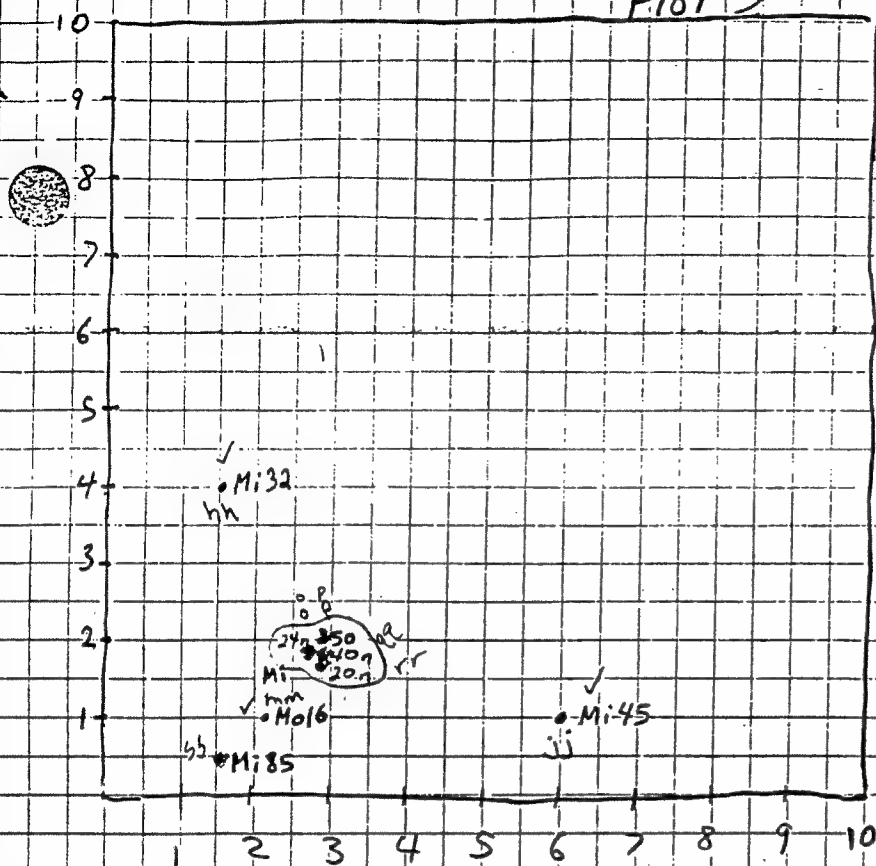
wet area

Plot 3

July 16, 1996

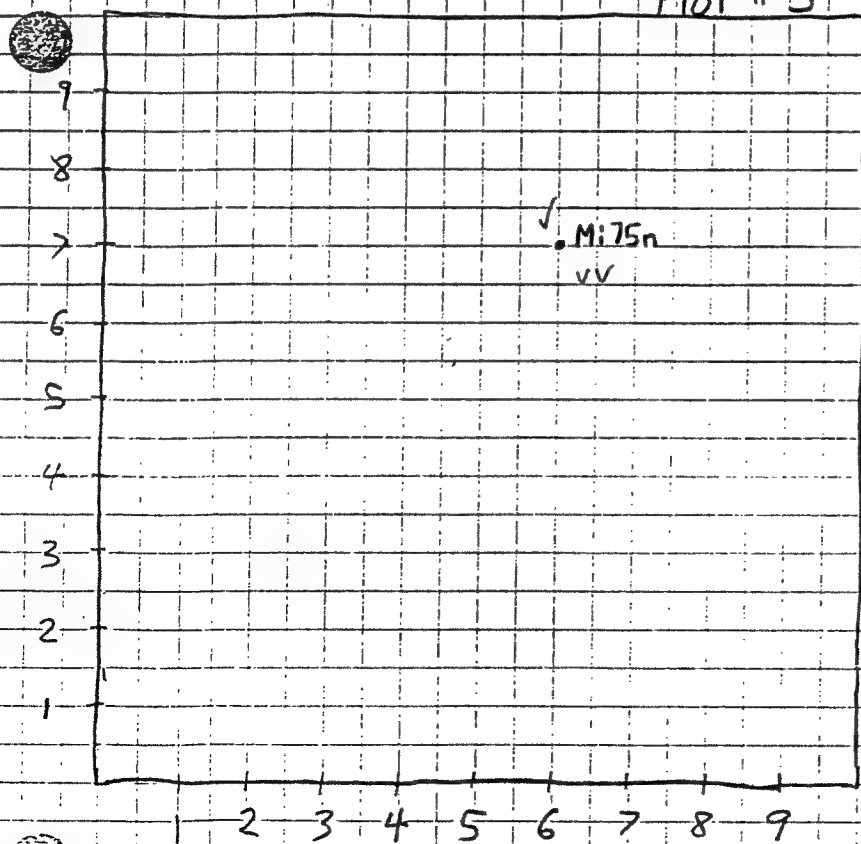
French Mud Pickins TS

Transect #2  
sheet 2 of 2



Plot 4  
all wet, void of  
Bot species

Plot #5





French Mud Dickens T.S. 7/16/96

7/16/96

plot #1

Transect #3  
control plots  
Sheet #1 of 2  
Mi = minganense

$M_i = \text{minganense}$

damp swale

2 = new

~~plot #2~~

Drier high ground

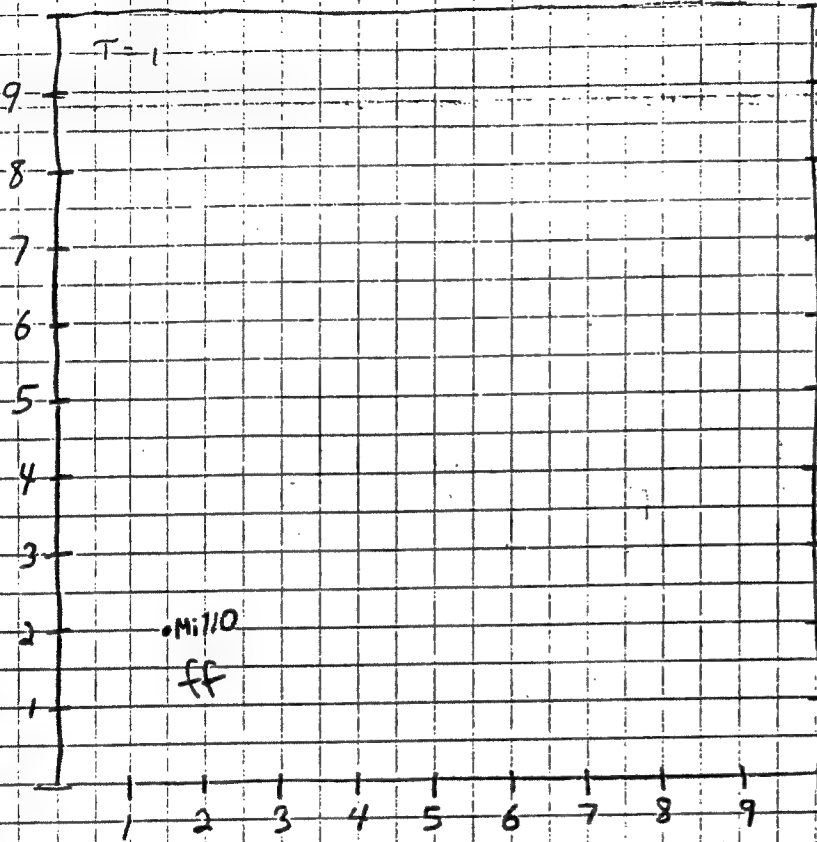
Ydd

French Mud Pickens TS

7/16/96

Transect #3  
Sheet 2 of 2

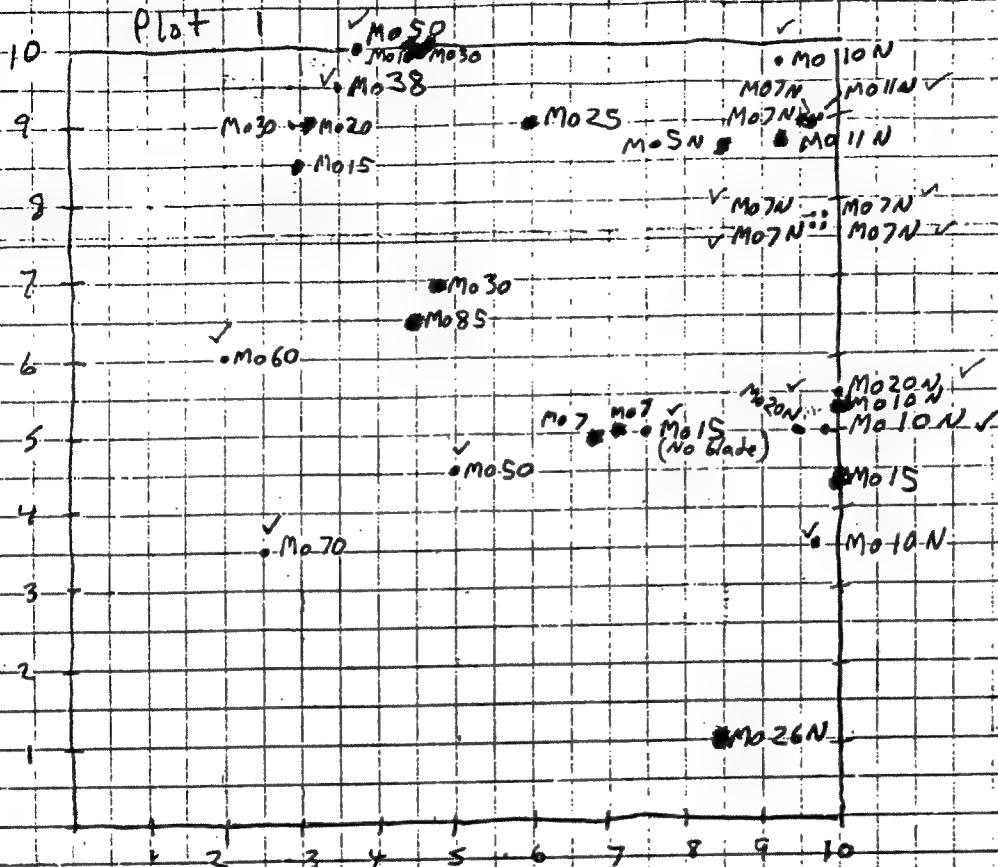
plot #3



3 Sept. 1996

French Creek  
Transect 1

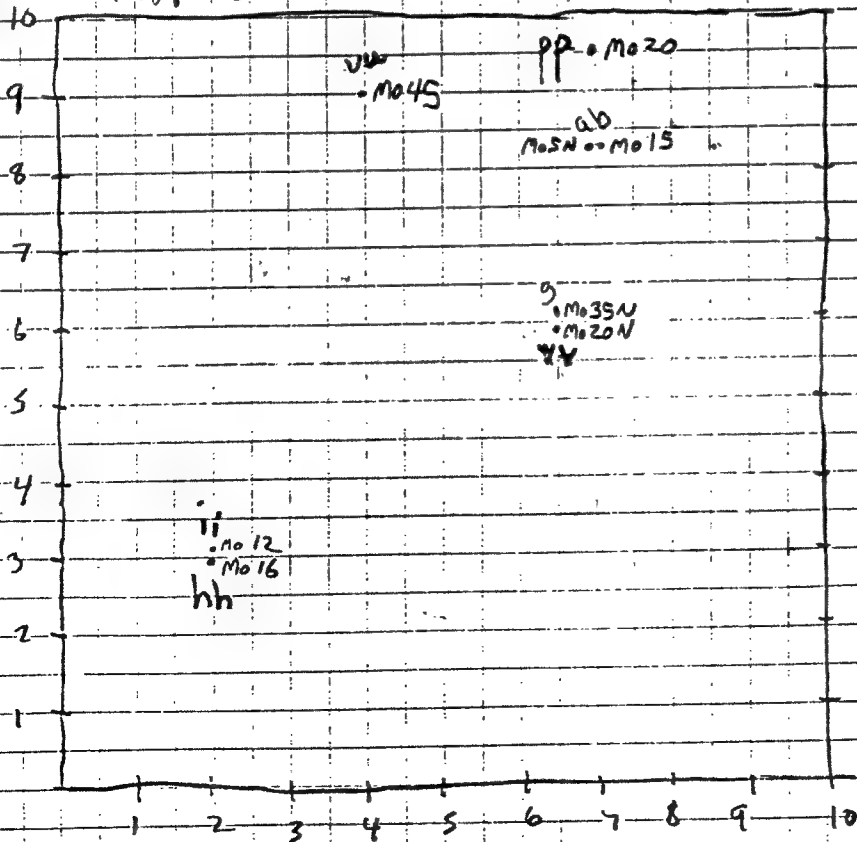
Plot 1



$t = 34$

$n_{ew} = 16$

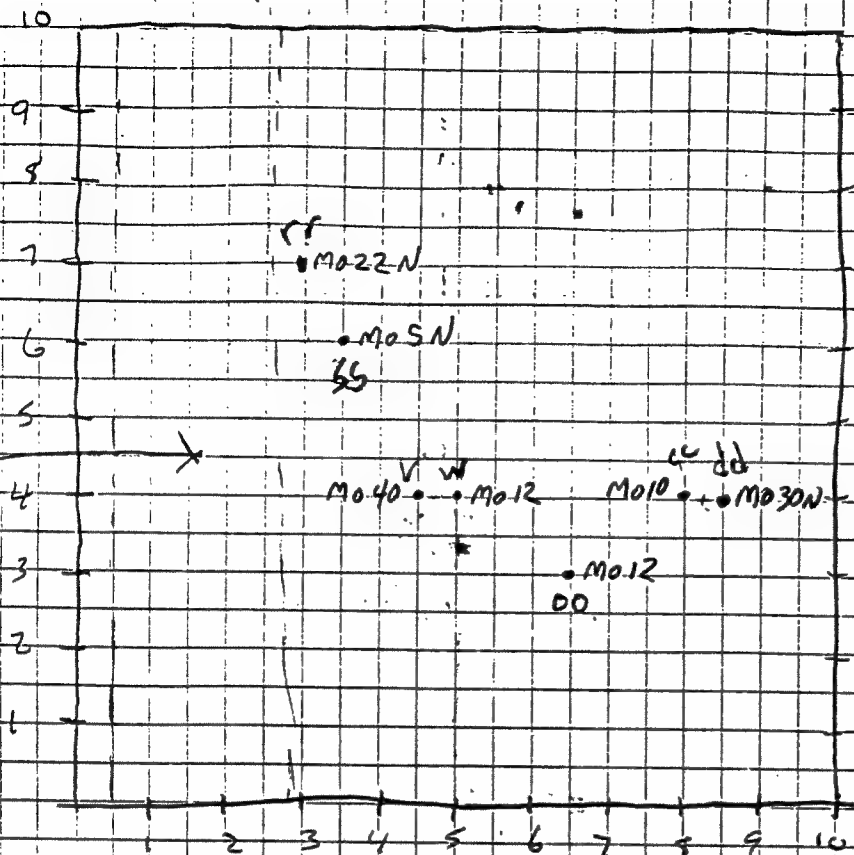
Plot 2



$t =$

Decomposed 400

Decomposed 400



Transect 1  
3 Sept, 1946

Hand-drawn scatter plot on grid paper showing the relationship between Mo12N (x-axis) and Mo13 (y-axis). The axes are labeled 1 to 10. Data points are labeled with Mo12N values and some with Mo13 values.

Mo12N	Mo13
1	3.5
3	5
7	7.5
9	4

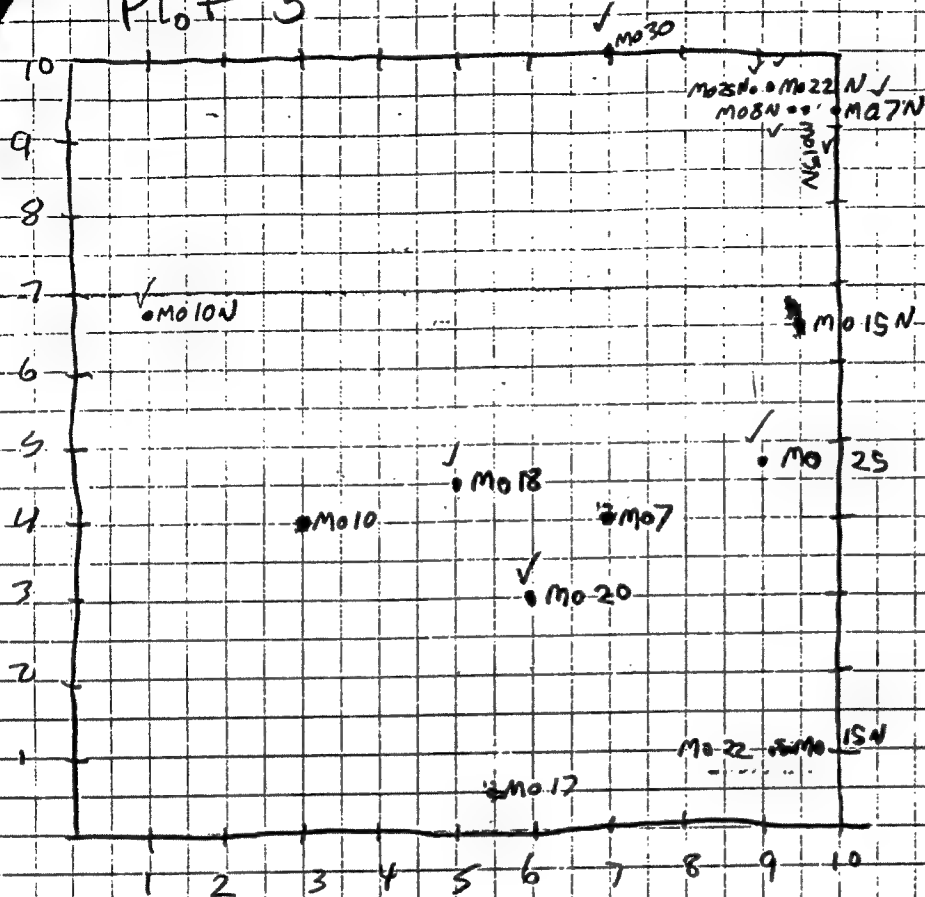
$$= 12$$
$$t = 23$$

Plot 5

3 Sept. 1996

French Creek

Transect 1



t=16

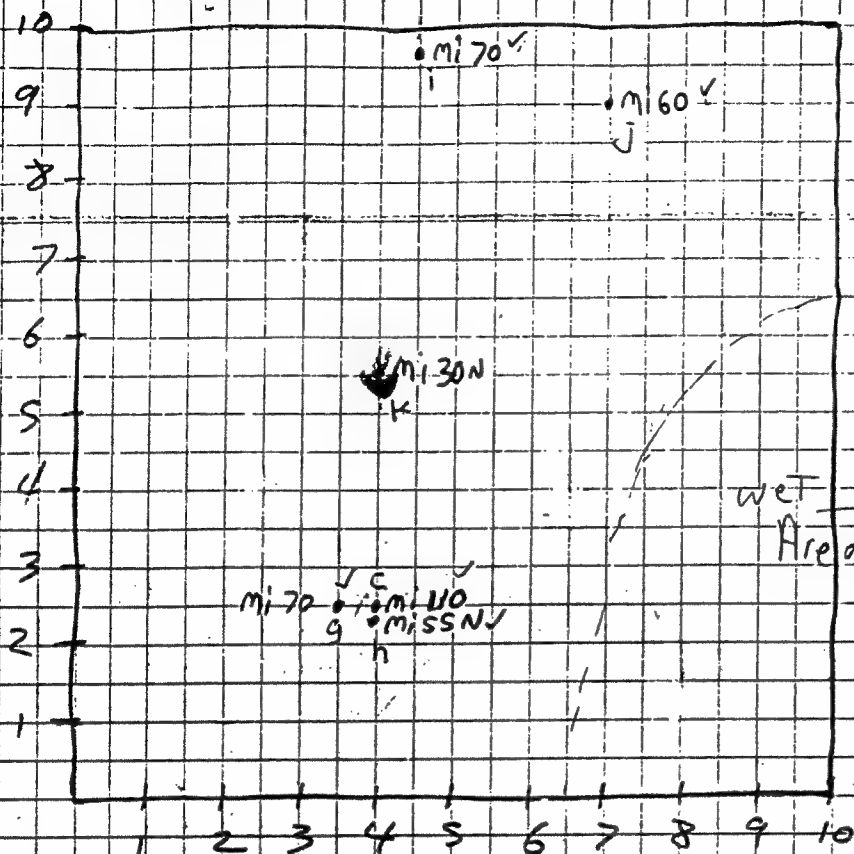
t=5

# Transect 2

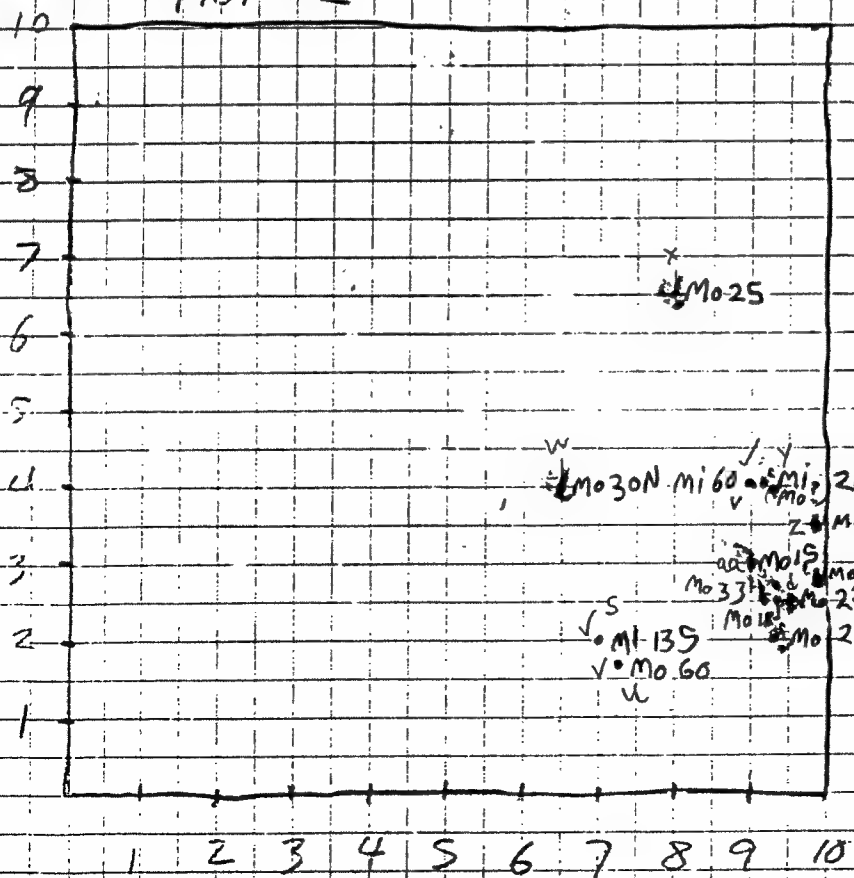
Plot #1

French Mud Picking  
Botrychium monitoring

Sept. 3 1996

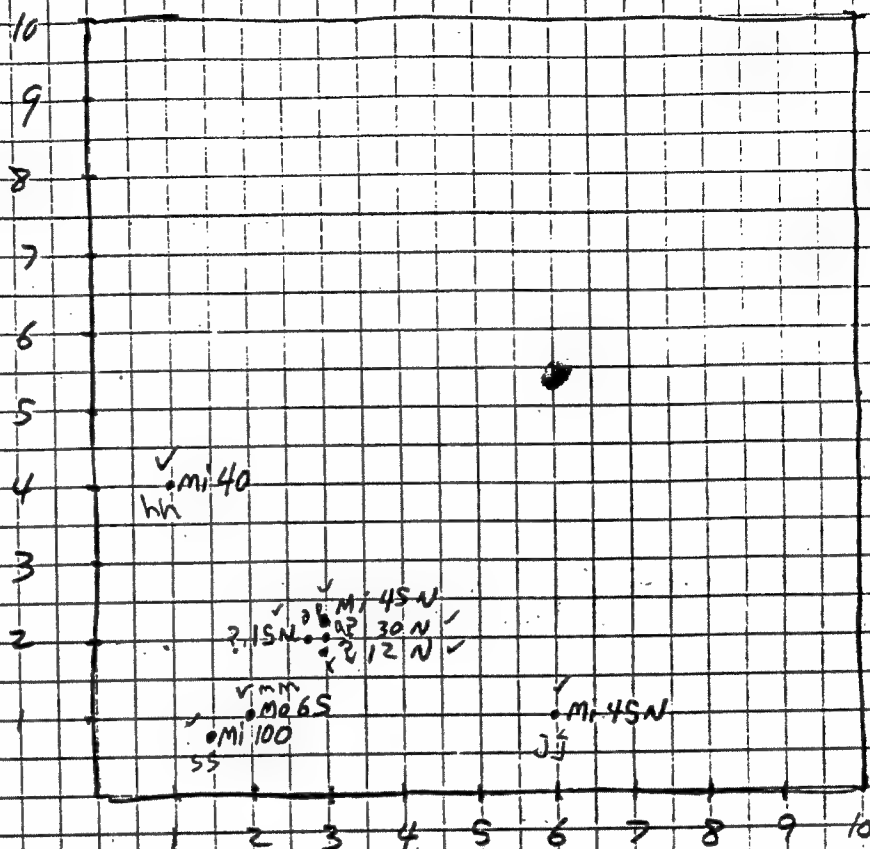


Plot #2



Sept. 3 1996  
Transect #2

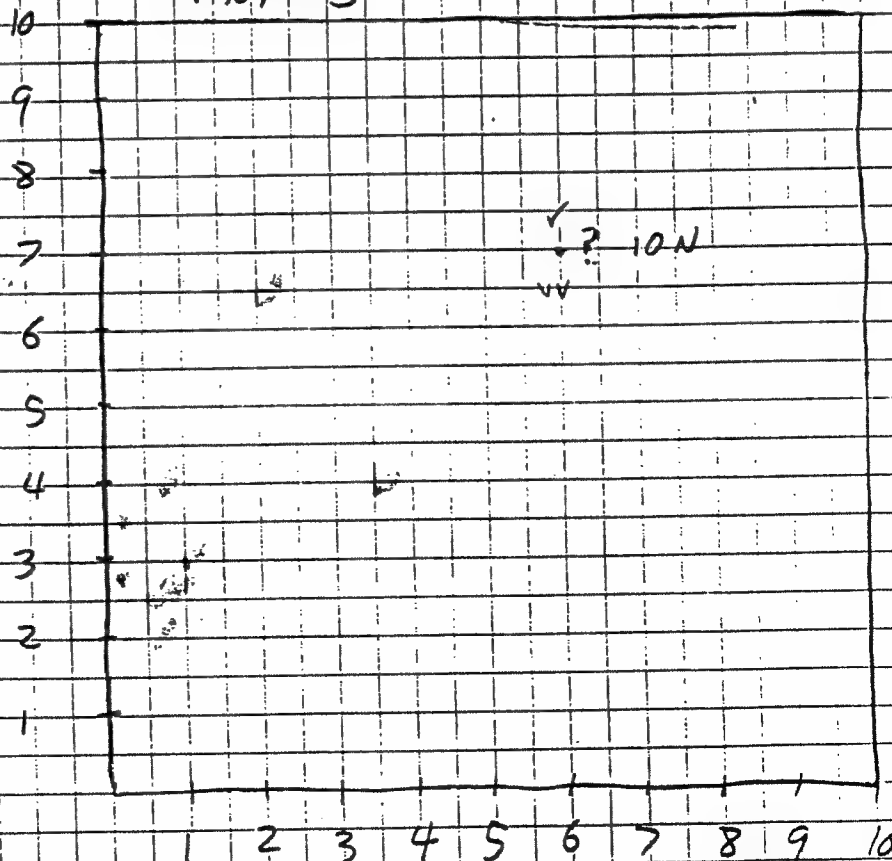
PLOT #3



Plot #4

No Bot. Species

P107 #5





## APPENDIX E: MOONWORT COLLECTION GUIDELINES

By J. Vanderhorst and B. L. Heidel

Herbarium specimen vouchers remain the most accepted method of verifying field identifications and documenting occurrences. Collection of moonworts (Botrychium subg. Botrychium) is especially important because of the difficulty in their identification, and the recurrent phenomenon in which multiple species occur at a single site. These guidelines represent an elaboration of the general collecting guidelines of the Montana Native Plant Society (1993) with particular reference to the biology of moonworts, their vulnerability, and the collecting considerations that are necessary and useful for making determinations (Windham pers. commun, Zika pers. commun.).

- Plants should be collected in mature, fully expanded stages. Plants collected early in the season usually do not have completely expanded fronds. Juvenile plants may appear late in the growing season for some species, and even late season juveniles do not have typical leaf morphology. In both cases, plants are likely to be unidentifiable, and their collection is a waste.
- Only the current year's above ground leaf should be taken, except for studies of chromosomes, mycorrhizal associations, and gametophytes, which are beyond the scope of most sensitive plant program projects. The leaf primordia are enclosed within the sheath at the base of the leaf, and if left intact, the plant is expected to survive. Monitoring over the course of the growing season at French Creek suggests that populations of moonworts endure certain levels of herbivory; additional years data may confirm this hypothesis.
- Where population size is large enough to support a collection (over 20 individuals) but still small (less than app. 50 individuals), collection should take place only after spore dispersal has occurred. At this stage, impacts to the potential reproduction and growth are lowest. Spore dispersal occurs late in the growing season (August- October depending on the species and climate).
- Distinct morphological forms are to be sought at the onset of a visit. The emphasis should be on collecting plants that represent typical morphologies in the population(s). Several plants, ideally 5-6 fronds, of each morphological type (putative species) within a site should be collected to display variation as population sizes permit.
- Notes should be taken on color, texture and other plant characters which are lost in pressing and drying (e.g., glossy, glaucous, brown-based stem, red stripe on mid-vein, etc.). These notes should be included on the herbarium label. An accompanying close-up photograph may be useful.
- Special care must be taken in pressing the plants. Zika and Wagner recommend using telephone books with heavy pressure rather than a typical plant press. The plants must be spread out perfectly flat to show the entire outline of the frond so that pinnae do not fold over or overlap (unless that is a characteristic of living plants), and trophophore and sporophore do not overlap.



- As with all plant collections, sufficient data should be collected and included on a typed label accompanying the plants. Data should include country, state, county, geographical province and locality (creek, mountain etc.), legal description, elevation, topography, substrate composition, moisture, and texture, associated vegetation including other moonworts, shade or sun, plant characteristics lost in pressing and drying, date, collector, and collection number.

- Close-up photographs have to substitute for specimen vouchers in small populations where determination is held in question. They should show full length of the plant, leaflet outline, and leaflet venation.

- Repeated collections of the same species from a documented population and other collecting which does not contribute to botanical understanding are counter to species' conservation.

- Collections and their label data should be deposited in herbaria. Primary collections from this project have been and will be sent to the University of Montana (MONTU), which has the states largest holding of the genus, to facilitate future annotation and taxonomic revision by experts. Specimens have also been deposited in the herbaria of taxonomists making determinations and verifications (Peter Zika, Oregon State University; W. H. Wagner, University of Michigan), and to Forest Service and other regional herbaria including Montana State University (MONT) and Intermountain Research Station (MRC).

- Verification of specimens is recommended for all collections by botanists working with moonworts for the first time. It is also advised for specimens that document range extensions. Photocopies of specimens can be used for making verifications, at the light setting showing clearest vein patterns. Color photocopies are especially useful and should be taken as soon as possible after pressing for fresh color representation. Some out-of-state experts will prefer to have specimens deposited as gifts in their herbaria. Taxonomists should be contacted prior to sending specimens to determine if they are able to take the time to make determinations. Below is a partial listing of taxonomists who are providing consultation at this time; this list of contacts will be updated as appropriate:

Instate

Toby Spribille, Kootenai National Forest, Fortine Ranger District, P.O. Box 116, Fortine, MT 59918

Jim Vanderhorst, P.O. Box 1026, Troy, MT 59935

Out-of-state

Warren H. Wagner, Department of Biology, University of Michigan, Ann Arbor, MI 48109-1048. telephone: (313) 764-1484. email: whwag@umich.edu

Peter Zika, Herbarium, Department of Botany and Plant Pathology. Oregon State University. Corvallis, OR 97331.

APPENDIX F: Fungi associated with sensitive moonworts on the Kootenai National Forest identified by Larry Evans. a=Alexander Mountain, c=Can Creek, f=French Creek, k=Kelsey Creek, rb=Roderick Butte, rt=Red Top, s=Sutton Creek, wp= West Pipe, z=Zulu Creek.

### Basidiomycetes

Armillaria mellea (group) s  
Camarophyllus subviolaceus k  
Clavariadelphus ligula k s  
C. truncatus k  
Clavulina corniculata f  
C. cristata k  
Clavulinopsis aurantio-cinnabarina s  
C. sp. rt  
C. corniculata s  
C. dichotoma? k  
C. laeticolor k s  
Clitocybe clavipes f  
Collybia acervata k  
Coprinus plicatus a  
Cortinarius bulbopodium (group) wp  
C. cinnamomeus (group) k  
C. laniger k  
C. sp. a  
C. sp. s  
C. sp. (brown) s  
C. sp. (fibrillose cap) k  
Fuscoboletinus aeruginascens f p  
Galerina sp. s  
Heboloma crustuliniformis f  
Hygrocybe coccineus k s  
H. miniata s  
Hypholoma capnoides k  
H. conicus k  
H. miniatus k  
Hygrophorus eburneus f k  
Inocybe geophylla a  
I. laetior a  
I. maculata a  
I. sp. k  
Lactarius alnicola rb  
L. sanguifluus f k  
L. zonata (group) z  
Leucopaxillus albissimus a  
Leptonia exalbida k

### Basidiomycetes continued

L. nigroviolacea k s  
L. parva s  
L. undulata s  
Marasmiellus candidus (group) f s  
Marasmius androsaceus a k p  
Mycena alcalina k  
M. pura k s  
M. sp. f  
Naematoloma capnoides k  
Paneolus campanulatus a  
Pleurotus elongatipes s  
Pluteus cervinus a  
Psathyrella gracilis (group) s  
P. longistriata s  
Russula abetina f k p  
Suillus fuscotomentosus k  
S. grevillei f p  
S. sibericus or S. umbonatus c  
Tricholoma saponaceum p  
Tricholomopsis rutilans k s

### Ascomycetes

Hypomyces sp. on Russula sp. k  
Chlorocyboria aeruginascens k  
Podostroma alutaceum s  
Spathularia flava f k a

APPENDIX G: Mosses associated with sensitive *Botrychium* species on the Kootenai National Forest. Specimens identified by Joe Elliott and collected by Joe Elliott, Jim Vanderhorst, or Terese Bielak.

*Aulacomnium palustre* K\*  
*Brachythecium* sp. Br, E  
*Brachythecium albicans* A, AM  
*Brachythecium asperimum* AM, Ho  
*Brachythecium erythrorhizon* AM  
*Brachythecium plumosum* WP  
*Brachythecium rutabulum?* K  
*Bryum* sp. Ch  
*Bryum pseudotriquetrum* AM, Ho  
*Dicranum scoparium* K  
*Drepanocladus fluitans* AM  
*Eurhynchium oreganum* Su, Z  
*Eurhynchium pulchellum* Ca, Ro  
*Hypnum pratense* Sw  
*Mnium thomsonii* K, RT  
*Plagiomnium cuspidatum* Ho, RT  
*Plagiomnium drummondii* K  
*Plagiomnium insigne* A, AM, Be, BM, Su, Z  
*Plagiomnium medium?* Ba  
*Plagiomnium venustum* E  
*Pleurozium schreberi* UC  
*Pohlia* sp. WP  
*Ptilium crista-castrensis* K  
*Rhizomnium magnifolium* Ch, He, Z  
*Rhizomnium nudum* P, Z  
*Rhizomnium pseudopunctatum* Fo  
*Rhytidiopsis robusta* F, Su  
*Roellia roellia* Fo, RT  
*Sanionia uncinata* E  
*Timmia austriaca* F, Su

\* A = Alexander Ck. (*B. crenulatum* 010), AM = Alexander Mountain (*B. crenulatum* 005), Ba = Beaver Ck. (*B. ascendens* 003, *B. crenulatum* 007), Be = Beetle Creek (*B. minganense* 033), BM = Berray Mountain Cedars (*B. montanum* 017), Br = Bristow Ck. (*B. crenulatum* 011), Ca = Can Creek (*B. minganense* 044, *B. montanum* 011), Ch = Chief Ck. (*B. crenulatum* 009), E = Everett Ck. (*B. montanum* 021), Fr = French Ck. (*B. minganense* 021, *B. montanum* 020), Fo = Forest Creek (*B. minganense* 040, He = Hemlock Ck. (*B. minganense* 037), Ho Houghton Ck. (*B. ascendens* 004, *B. montanum* 026), K = Kelsey Ck. (*B. minganense* 025, *B. montanum* 012), P = Pipe Ck. (*B. montanum* 016), Ro = Roderick Butte (*B. montanum* 018), RT = Red Top Ck. (*B. minganense* 038, *B. montanum* 022), Su = Sutton Ck. (*B. minganense* 049, *B. montanum* 024, *B. pedunculatum* 004), Sw = Swamp Creek (*B. crenulatum* 008), UC = Upper Can Ck. (*B. montanum* 009), WP = West Pipe Ck. (*B. montanum* 013), Z = Zulu Ck. (*B. minganense* 028, *B. montanum* 015, *B. paradoxum* 010)

APPENDIX H: U.S. Forest service Region 1 sensitive plant scoring criteria.

Table of sensitive plant criteria scores for sensitive and proposed sensitive *Botrychium* species on the Kootenai National Forest. Scored by J. Vanderhorst January, 1997.

species/criteria*	1	2	3	4	5	total
<i>B. ascendens</i>	9	4	3	3	1	20
<i>B. crenulatum</i>	6	4	3	3	1	17
<i>B. minganense</i>	0	0	9	1	1	11
<i>B. montanum</i>	3	4	9	3	1	20
<i>B. paradoxum</i>	6	4	3	1	1	15
<i>B. pedunculosum</i>	9	4	3	3	3	22

**\*1. ABUNDANCE**

- 9 Extremely rare: 5 or fewer known populations or an estimated total number of individuals of less than 1000 within Region 1.
- 6 Rare: From 6-20 known populations or an estimated total number of individuals between 1000 and 3000 within Region 1.
- 3 Uncommon: From 21-50 known populations or an estimated total number of individuals between 3000 and 10,000 within Region 1.
- 0 Common to abundant: Greater than 50 known populations or more than 10,000 individuals within Region 1.

**2. DISTRIBUTION**

- 6 Local endemic: Limited to one locale and/or occurs on only 1-2 National Forests or Grasslands.
- 4 Regional endemic: Occurs on more than 2 National Forests or Grasslands.
- 3 Disjunct (isolated) outlier: Occurs beyond the general perimeter of the range.
- 2 Peripheral: At edge of range.
- 0 Widespread: None of the above.

### **3. DEGREE OF THREAT OF HABITAT LOSS**

- 9     High: Habitat directly threatened by habitat manipulation.
- 6     Moderate: Habitat moderately threatened by habitat manipulation.
- 3     Low: Habitat infrequently threatened by habitat manipulation.
- 0     None: Habitat not currently threatened by habitat manipulation.

NOTE: The "low" category was added during scoring of Montana plants, as many species seemed to fall between 0 and 6 for this criterion.

### **4. SPECIALIZED HABITAT/ECOLOGICAL AMPLITUDE**

- 3     Narrow: Species is restricted to a unique or limited habitat or combination of habitats, and/or species has a high degree of habitat specificity.
- 1     Intermediate: Species is restricted to a relatively unique habitat or combination of habitats, and/or species has a moderate degree of habitat specificity.
- 0     No: Species is not restricted to unique habitats.

### **5. DOWNWARD TREND**

- 3     Yes: Known or strongly suspected that species has suffered declines historically.
- 1     Possible: Information lacking, but downward trend a possibility.
- 0     No: No indication that species has suffered declines.

## APPENDIX I: PHOTOGRAPHIC SLIDES

1. Beaver Creek, ECODATA Plot FS01140395JV002; Botrychium ascendens (003), B. crenulatum (007).
2. B. crenulatum at Alexander Creek (010).
3. B. crenulatum habitat at Alexander Creek (010).
4. B. crenulatum at Chief Creek (009).
5. B. crenulatum habitat at Chief Creek (009).
6. B. minganense at French Creek (021).
7. B. montanum at French Creek (020).
8. Habitat at French Creek, B. minganense (021), B. montanum (020).
9. Habitat at Red Top Creek, B. minganense (038), B. montanum (022).
10. Red Top Creek, from clearcut towards old growth cedar B. minganense (021) habitat.
11. Red Top Creek, ECODATA Plot FS01140295JV006; B. minganense (021).
12. Red Top Creek, ECODATA Plot FS01140295JV007; clearcut adjacent to Botrychium genus community.
13. B. montanum at Can Creek (011).
14. B. montanum habitat at Can Creek (011).
15. B. montanum at Can Creek (011).
16. B. minganense at Can Creek (044).
17. B. minganense and associated fungus at Upper Can Creek (030).
18. B. minganense at Cedar Creek (027).
19. Habitat at Cedar Creek; B. minganense (027), B. montanum (014).
20. Habitat at Cedar Creek; B. minganense (027), B. montanum (014).
21. B. minganense at Fowler Creek (039).
22. B. minganense habitat at Forest Creek (040).
23. B. minganense habitat at Beetle Creek (033).
24. B. minganense at Hemlock Creek (037).
25. B. minganense at Ross Creek Cedars (010).
26. B. minganense habitat at Ross Creek Cedars (010).
27. B. montanum at Roderick Butte (018).
28. B. montanum habitat at Roderick Butte (018).
29. B. montanum at Kelsey Creek (012).
30. B. montanum habitat at Kelsey Creek (012).
31. B. minganense at Kelsey Creek (025).
32. B. minganense habitat at Kelsey Creek (025).
33. B. minganense habitat at Purcell Ridge (029).
34. B. montanum habitat at West Pipe Creek (013).
35. B. montanum at Berray Cedars (017).
36. B. montanum habitat at Berray Cedars (017).
37. B. montanum at Clay Mountain (019).
38. B. montanum habitat at Clay Mountain (019).
39. B. minganense at Zulu Creek (028).
40. B. paradoxum at Zulu Creek (010).
41. Botrychium sp. ? at Zulu Creek.

42. Zulu Creek, ECODATA Plot FS01140495JV008; B. minganense (028), B. montanum (015), B. paradoxum (010).
43. French Creek demographic monitoring transect #1; B. montanum (020).
44. French Creek demographic monitoring transect #1.
45. French Creek demographic monitoring transect #1.
46. French Creek demographic monitoring transect #2; B. minganense (021), B. montanum (020).
47. French Creek demographic monitoring transect # 2.
48. French Creek demographic monitoring transect # 2.
49. French Creek demographic monitoring transect # 3; B. minganense (021).
50. French Creek demographic monitoring transect # 3.

Slides 51-55 contributed by Leslie Ferguson.

51. French Creek; Botrychium sp.?, with branched frond.
52. French Creek; Botrychium sp.?
53. French Creek; Botrychium sp.?
54. French Creek; Botrychium sp.?
55. Keeler Creek habitat; Botrychium pedunculosum (003).
56. South Fork Big Creek; ECODATA Plot FS01140196JV006; B. minganense (046), B. montanum (029), B. pedunculosum (001).
57. West Pipe Creek; ECODATA Plot FS01140596JV005; B. minganense (026), B. montanum (013).
58. Swamp Creek; ECODATA Plot FS01140396JV004; B. crenulatum (008).
59. Pete Creek; ECODATA Plot FS01140296JV009; B. minganense (032).
60. Alexander Creek; ECODATA Plot FS01140596JV002; B. crenulatum (010).
61. Bunker Hill Creek; ECODATA Plot FS01140496JV015; B. minganense (017).
62. B. minganense; Bunker Hill Creek (017).
63. Bull River; ECODATA Plot FS01140796JV014; B. minganense (047).
64. B. minganense; Bull River (047).
65. Othorp-Morgan Lake; ECODATA Plot FS011403TS055; B. minganense (066).
66. B. minganense? or "B. sublunaria"; Othorp- Morgan Lake (066).
67. B. pedunculosum; Keeler Creek (003).
68. B. pedunculosum; Big Creek (005).
69. B. pedunculosum; Big Creek (005).
70. Botrychium sp.?; French Creek.

All slides taken by J. Vanderhorst, except 51-54, taken by L. Ferguson. Slides 1-54 submitted with draft status report in 1996. Slides 55-70 submitted with final conservation assessment in 1997.